

DEVELOPMENT OF THE TFX F-111 IN THE DEPARTMENT OF DEFENSE'S
SEARCH FOR MULTI-MISSION, JOINT-SERVICE
AERIAL PLATFORMS

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ABSTRACT

DEVELOPMENT OF THE TFX F-111 IN THE DEPARTMENT OF DEFENSE'S
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by Major Brian L. Reece, 169 pages.

In 1961, the new Secretary of Defense, Robert McNamara directed a joint aircraft acquisition program called the TFX, which would produce the first common aerial platform for multiple services. The resulting drama, subterfuge and resistance by the Air Force, the Navy and multiple sources inside and out of the Department of Defense caused the program to fail.

This paper is a historical look at the different points of view and agendas of the Air Force, Navy and Civilian Government Leaders who influenced the results of the program. It attempts to isolate the factors that influence a joint acquisitions program that were non-existent in other single service developments.

Following a chronological development of the program from each perspective helps give understanding and reference to the issues that affected the TFX. Analysis of these perceptions shows how some of these same concerns and challenges present themselves in future joint aircraft ventures.

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ACRONYMS

AR	Arkansas
BuWeap	Bureau of Naval Weapons
D	Democrat
DoD	Department of Defense
DDR&E	Department of Defense Research and Engineering
EF	Electronic Warfare/Fighter
FB	Fighter/Bomber
FOD	Foreign Object Damage
FX	Fighter Experimental
MA	Massachusetts
MiG	Mikoyan and Gurevich Russian Aircraft Company
NASA	National Aeronautics and Space Administration
SAM	Surface to Air Missile
SOR	Specific Operational Requirement
SPO	Special Project Office
SWIP	Super Weight Improvement Program
TFX	Tactical Fighter Experimental
VAX	Attack Aircraft Experimental
US	United States

CHAPTER 1

INTRODUCTION

Secretary of Defense Robert McNamara ushered in a new era of military aircraft development on 14 February 1961. He was tired of old ideas in weapons development and duplication of effort; he wanted to find a more efficient and cost effective manner for acquisition of high-end goods for the services. McNamara mandated that all of the services would coordinate requirements for a single aircraft to meet all four services' needs. Although the program was narrowed to only affect the Air Force and Navy, the Tactical Fighter Experimental (TFX) project was the birth of the joint aircraft acquisition process.

The TFX was a subject of controversy from the beginning. The idea of joint development was a foreign concept to the services that had, up to that point, relative autonomy in development of their aircraft needs. McNamara was not only changing the way that services would acquire aircraft; he was adding a new level of oversight that questioned the services' independence. Forced into a joint acquisition, the Air Force and Navy chose the aircraft they wanted, but McNamara disagreed with their choice. The backlash against the unilateral decision overturning both services' recommendations was felt throughout the rest of the program's life. McNamara tried to exert his personal will to make joint aircraft development a reality, but it was not enough in the long run. TFX was plagued by a number of unforeseen factors that continue to plague the aircraft industry to this day.

Between 1961 and 1968, a battle raged between the Department of Defense, Air Force, Navy and Congress over the application and development of the TFX, later

designated as the F-111. The Air Force eventually bought 563 aircraft, configured in eight different versions. It flew operationally from 1967 until 1996, almost 30 years of active service.¹ However, the TFX was viewed by the military as a failed experiment in joint development. The Navy only purchased eight of the originally planned 335.² The perceived failure of the program was wrapped up in the personalities of the players, the multi-mission aspects of the aircraft and the inability of the services to accept an aircraft that was not built and led by the parent service. The Navy and Air Force left the TFX project with such disdain for the joint process that their next several aircraft were single-source developed. This mentality is always short lived, as the Department of Defense still attempts large joint aircraft projects approximately every twenty years and experiences many of the same stumbling blocks as previous attempts. If the Department of Defense plans on continuing to build joint service aircraft, they should understand what went right and wrong from the very first attempt in order to appreciate what pitfalls and problems will arise in future endeavors.

The problems that the services and all related agencies encountered in building the TFX project can be expected in any future joint acquisition project. These problems are inherent to any development where there are joint requirements. However, comprehending not only what the problems are, but where they originate, is vital to predicting where they may arise again in future venture.

From a historical analysis of the life of the program and all players involved, it is difficult to ascertain why the joint TFX ended with only one service acquiring the aircraft. This question is not easily answered, and can be daunting to anyone wanting to take a look at the issues involved with the entire process. The TFX program started in

1961, and did not end as a joint program until March of 1968, after McNamara had resigned and Congress had conducted two separate multi-year investigations of the project. It captured national attention for over six years and spawned multiple books, all printed during the F-111's acquisition.

There are secondary questions that become apparent almost immediately upon investigation. What effect did the history of the services' acquisition programs and their standing within the military industrial complex have on their views going into a joint acquisition project? How did the players normally involved with aircraft development change when it became a joint acquisition and what were their motivations? How did technology play into joint acquisition; is it a cause or an effect of the joint process? Did the motivations of internal players change when the project elevated to a higher level? What were the national policy player motivations when a final aircraft was chosen? And most importantly, how are the frictions of multiple mission and joint acquisition resolved?

Robert Art was the first historical author to do serious work on the TFX program. His book, *The TFX Decision: McNamara and the Military*, took an in-depth look at the selection process of the aircraft itself.³ He explored most of the contemporary issues associated with the aircraft competition, covering only the events between 1961 and 1963. He referenced the first round of Senate TFX Hearings and did an excellent job describing some of the events and timelines associated with the beginning of TFX. However, his account ends right after selection and does not cover what happened after McNamara made his decision to go with the General Dynamics aircraft. Another deficiency of his book was that he failed to look at the factors leading to the problems

within the services. He focused almost entirely on McNamara and his needs during the development of the requirements.

Robert Coulam continued Art's narrative with his book, *Illusions of Choice: The F-111 and the Problem of Weapons Acquisition Reform*.⁴ Coulam's book covers the period of 1963 until 1968 when the Navy project was cancelled. His account is in-depth and includes both the first and second Senate TFX Hearings until their conclusion in 1968. Coulam also conducted a great number of interviews with development team members and aircraft industry professionals from Boeing and General Dynamics. His coverage of the issue gives much needed first-hand accounts of the thoughts and motivations of the players, though he often did not discuss those motivations fully. Coulam is very focused on addressing the TFX from the perspective of cybernetic design. This was his philosophy on the issues associated with the TFX and why he viewed the program as a failure. Coulam took a great deal of time exploring the engineering challenges of the program, something that is involved in every complicated aircraft design. He also focused almost exclusively on the Navy, blaming their attitude and actions for a large amount of the failure of the program. While his analysis was very compelling, it failed to tell the entire story, especially of all the players involved in the decisions. Both Art and Coulam were quick to point out and focus on a single player they felt held the greatest amount of influence on the results.

Another book published about the same time was William Kauffman's, *The McNamara Strategy*, published before McNamara left office.⁵ This book highlighted some of the thoughts and ideas that McNamara had during the development of the TFX. Though the book mostly focuses on Vietnam and other military events of the time, it does

describe the frame of mind McNamara was in when trying to work through the TFX program's issues. It helps substantiate that multiple players influenced the results of this program.

The problems of the TFX have not been analyzed with a historical reference and with time to let the dust settle and emotions cool. Almost all of the contemporary work on the subject was written with a point of view and many times an agenda. Another problem with work accomplished on the subject is that no one source takes into account all of the possible players and their frame of reference regarding the TFX.

This paper will help dispel and clarify many of the issues previously covered on the TFX. First, the subject will be covered from three distinct points of view, namely the Air Force, the Navy and the civilian agencies. When discussing the Air Force and Navy, some of the background of each service between 1945 and 1961 is covered in order to ensure an understanding of their motivations. The Air Force and Navy decisions in 1961 are a direct result of their previous standing within the military and their relative priority of funding from Congress. Several projects predate the TFX and offer a great deal of context as to why the services behaved in a certain manner. It is impossible to assume that the services were acting without self-interest. Also, the civilian agencies include more than just the Secretary of Defense. While Robert McNamara played a huge role in the project development and demands a large share of the focus, there were many more players involved.

Key players will be a focus of this paper. Understanding the motivations and histories of this group of actors will help unlock why they acted the way that they did. The key individuals discussed include Robert McNamara, Frank Everest, Curtis LeMay,

Harold Brown, Paul Nitze, Thomas Connelly, Alain Enthoven, Paul Hammond, Paul Ignatius, John F. Kennedy, Dwight Eisenhower, Department of Defense Research and Engineering (DDR&E), Congress, Fred Korth, John McClellan, National Aeronautics and Space Administration (NASA), John Stack, Herbert York, Eugene Zuckert, George Anderson, Frederick Ashworth, Robert Pirie and Lyndon Johnson. These are just some of the main players, with many others offering key influences on the program. Previous discussions on the TFX program fail to recognize the span of control these people had and their individual influences on the program.

One of the reasons that the history of this project is so difficult to reconstruct is that it is rarely studied in chronological order. Historical events lend themselves to a chronological layout, but previous TFX coverage tells the story by issue rather than chronology. The sheer number of issues and players makes this understandable, as it is hard to tell the story from all perspectives and have it make sense. Therefore, in this paper the issue is discussed first by the service or agency perspective and secondly by chronological order. Each section will reset and tell the same basic events, but from a different point of view. This preserves the perspective and chronological order needed to understand the TFX program from start to finish.

Technological aspects and feasibility are often overlooked. When most of the contemporary research on this subject was completed, the F-111 was the most sophisticated aircraft in the inventory and many of the technologies were so new, it remained to be seen how they would affect the industry and be utilized by the services. Also, most of the technology remained classified for years following the plane's development and were unavailable to the researchers of the time. Exactly 50 years later,

the now declassified technology and how it was utilized is much clearer to both the community and historians. Additionally, many of the contemporary writers felt that multi-mission aircraft were a fad that would pass with the TFX. However, the opposite is true, and many policy makers now focus on multi-mission aircraft. This paper will not discuss the overall effectiveness of the aircraft in the years following 1968 or how it was utilized inside of the Air Force in conjunction with other aircraft. The focus is on the selection and development process and how that affected the services. Technology and its use in aircraft development will also be discussed.

One of the biggest problems with the research on the F-111 is distortion. People look through a lens of failure when discussing the aircraft. The TFX did fail as a joint acquisition program. The Navy never accumulated them in mass and no other service picked up the aircraft as one of their primary vehicles. These facts need to be separated from the aircraft itself, which both Art and Coulam both considered a failure. However, almost 30 years of effective service argues against that label. It was the method that failed and that process is the focus of discussion. Failures of development and shortcomings of the aircraft are an integral part of this understanding, but should not be directed as condemnation of the overall end result.

There are several limitations on this research. A discussion of the strategic and nuclear bombing roles between Strategic Air Command and Tactical Air Command are beyond the scope of this paper. The battles between LeMay and many of his generals are also beyond the scope of this paper, but it should be remembered that Curtis LeMay originated the idea of Strategic Air Command and therefore had many personal ties to the command. Also, discussion of nuclear bombing as a tactic is beyond the scope of this

paper. The thoughts of leaders and their treatment of nuclear strikes as either offensive or defensive weapons is a continuing debate to the present. Comparison to future joint acquisition programs is also beyond the scope. The V-22 Osprey and J-35 Joint Fighter Experimental are both examples of joint aircraft acquisition programs that have tumultuous histories and could easily be compared to the failings of the TFX joint program. However, their internal workings are too complicated for serious analysis in this paper.

This paper will rely on the interviews and research accomplished over the years by a multitude of different researchers. The TFX Hearings and Senate Budgetary Hearings are available and completely declassified for public use through archives. Though these are an excellent source of information, they are public records often given through testimony. It is impossible to ask additional questions of the key players or to conduct additional interviews of people involved with the program. It is also impossible to do a psychological breakdown of the main characters and to discuss in depth the motivations of their actions from an egocentric frame of reference. Any discussion of their motivations will be briefly summed up by accepted histories of the events or from their own biographies. It is also impossible to delve into the greater amount of Congressional interests in the program. There are a number of Congressional players, but only those who played key roles will be discussed along with their motivations in action.

There are a fair number of assumptions that must happen in order to complete the research on this subject. It has to be assumed that players told the truth either in their memoirs, interviews or while on the record before Congress. Along those same lines, it has to be understood that information that made a certain agency or individual look bad

was likely marginalized or even omitted. It has to be assumed a great deal of information never made it into the official records and is eternally lost to scrutiny. It is almost certain that personality conflicts played a role in development issues, but it is also assumed that these same personality conflicts and internal motivations will continue to be issues in future joint projects. The final assumption is that the TFX was a battleground for much larger issues. Agency and individual disdain for the F-111 often was not directed at the aircraft, but the process of development it represented.

The significance of this research is far-reaching and has a place even in the modern military complex. In fact, understanding the TFX is more relevant to now than in 1975. After fighting wars in two countries and battling extremism all over the globe for the last decade, the military is facing budgetary cutbacks while trying to modernize its fleet of aircraft. The rapid development of technology and success of other countries in duplicating our capabilities is driving a need for newer, technologically-based aircraft. The temptation is to develop joint acquisitions in order to save money and development time. There is even temptation to make every project joint in order to reduce waste and duplication of the military branches. While these decisions seem simple, frugal and politically viable, they carry with them inherent risk.

A comprehensive understanding of the historical background and consequences of actions in joint development is possible through a serious study of TFX F-111 development and how joint aircraft acquisition started. The decision to make something joint seemed easy and a simple solution to a large problem. However, the number of factors changed by this simple solution is staggering. Even in a modern, joint-oriented military, some of these problems are unavoidable if not understood as factors from the

start. The only way to understand these issues is to understand where they all began: the TFX. The Air Force is the logical first player to explore in this complicated drama.

¹Don Logan, *General Dynamics F-111 Aardvark* (Atglen, PA: Schiffer Military History, 1998), 13.

²Tommy Thomason, *Grumman Navy F-111B Swing Wing* (Simi Valley, CA: Steve Ginter, 1998), 17.

³Robert J. Art, *The TFX Decision: McNamara and the Military* (Boston: Little, Brown and Company, 1968), 2.

⁴Robert F. Coulam, *Illusions of Choice: The F-111 and the Problems of Weapons Acquisition Reform* (Princeton, NJ: Princeton University Press, 1977), 2.

⁵William H. Kaufmann, *The McNamara Strategy* (New York: Harper and Row, 1964), 3.

CHAPTER 2

TFX AND THE AIR FORCE PERSPECTIVE

The fifteen years leading up to the initial development of the TFX was extremely formative from the Air Force perspective. The technological changes during this period and the Air Force's favored status with politicians and the Department of Defense created a level of expectations that could never be maintained.¹ The Air Force's need for technologically advanced aircraft can be traced back to a single event.

No one fully anticipated the coming shift that occurred at 0815 on 6 August 1945. An American B-29 bomber dropped the first atomic bomb, "Little Boy," on Hiroshima; the blast incinerated an estimated 80,000 people and destroyed approximately 69 percent of the city's buildings.² By 0816, America and rest of the world entered a nuclear age that would dominate almost every aspect of military and political decision-making among the world's strongest nations.

Between 1945 and 1947, strategic nuclear defense became the top national security strategy priority. The US government split responsibility for the nuclear mission between the Army Air Forces and the Navy for implementation during a massive military drawdown. This relationship remained until the National Security Act of 1947 created an independent Air Force within the newly created Department of Defense (DoD).³ Nuclear weapons and defense were one of the few areas impervious to drawdown following the close of World War II, and the Navy quickly made a bid to control this industry.⁴ However, due to political influence, the US Air Force assumed control of the strategic nuclear defense mission when the Soviet Union successfully tested a nuclear weapon in 1949.⁵

Tactical Air Command was established originally under the Army Air Forces and became a major command to the Air Force upon its independence as a separate service. Tactical Air Command's mission was to provide a balance between strategic, tactical and air defense forces. This translated into three separate air missions: (1) close air support, (2) air superiority, and (3) air interdiction.⁶ None of these missions embraced the nuclear mission. That remained a separate tasking of Tactical Air Command. In 1950, Tactical Air Command had nineteen wings, but this number would increase to 34 by 1957 as its influence in the nuclear mission increased.⁷ Neither the US nor the USSR had effective delivery methods for their growing nuclear arsenals and Tactical Air Command offered the best solutions. Strategic Air Command's bombers were considered too slow and unreliable as a first strike weapon.⁸

Eisenhower's Secretary of State, John Foster Dulles, gave a speech in January 1954 that introduced the policy of Massive Retaliation, a policy that could only be implemented through numerous fighter-bombers. The integrated air defenses and the number of Russian jet aircraft precluded traditional bombing roles as the bedrock of nuclear deterrence. Massive Retaliation completely shifted the aerial focus from air superiority in favor of nuclear interdiction. The F-100 and Tactical Air Command were at the center of this national strategic capability, making the Air Force and Tactical Air Command the top tier for funding in the 1950s. A new aircraft was designed and implemented almost every three years for a period of fifteen years following 1945.⁹ Four of these were fighter-bombers, each designed to go faster than the one before. The Air Force's focus on speed became apparent when ordinance delivery capacity became a

secondary consideration to the Mach capabilities. When the F-105 first flew in 1955, it did not have the requirement to carry conventional weapons.¹⁰

With the launch of Sputnik on 4 October 1957, the United States frantically entered into a missile arms race with the Soviet Union.¹¹ Because the Air Force was the primary service for missile development, implementation and sustainment, the overall military focus on fighter-bombers declined almost overnight. By 1958, Tactical Air Command had its wings reduced from 34 to 26 in order to give more money to the fledgling missile development programs.¹² That same year, the F-105 Thunderchief became the premiere fighter-bomber as Tactical Air Command relied on this airframe to fulfill its nuclear requirements.

In 1959, Tactical Air Command went from 26 to eighteen wings as more assets flowed to United States Air Forces Europe at Lindsey Air Base, West Germany, as part of the ballistic missile program.¹³ Tactical Air Command and senior Air Force military officers watched resources be diverted to other agencies and programs as the number of wings and budget dollars evaporated. They needed to do something quickly to become a stronger piece of the nuclear triad or the new fascination with ballistic missiles would drive fighter-bombers completely out of existence. This fear was confirmed when General Lauris Norstad, Supreme Allied Commander in Europe, argued publicly that Air Force tactical aircraft in Europe were too vulnerable and should be completely replaced by medium range ballistic missiles.¹⁴ The Air Force immediately took significant steps to help secure funds for the development of a new tactical fighter.

General Frank F. Everest took command of Tactical Air Command from General Otto Weyland in 1959. His first act was to find a replacement for the F-105 that would

bring back dominance of the strategic fighter bomber.¹⁵ To the Air Force, Everest looked like the perfect officer to take command of the waning Tactical Air Command. A decorated and skilled pilot, he was a West Point graduate, fought against the Japanese and received the Silver Star for his efforts on Guadalcanal. He was promoted quickly, moving from Captain to Brigadier General in under four years.¹⁶ After World War II, Everest became the assistant deputy chief of staff for operations at Air Force Headquarters, and also assumed duty as the senior Air Force member on the Military Liaison Committee to the Atomic Energy Commission. He then became the commanding general of the Fifth Air Force, Far East Forces, in Korea. He had direct control over the development of fighter techniques used and lessons learned from the modern era of jet dog fighting. In 1957, General Everest became the US Air Forces Europe Commander, where he oversaw the employment of the now operational medium range ballistic missiles.¹⁷ This experience gave him the unique ability to see the limitations of both ballistic missiles and fighter-bombers.

Everest's background provides insight into the position he took with the F-105 replacement. First, as a trained fighter pilot in the Pacific theater, he understood the technological advantages that newer aircraft bring to the air superiority mission. Furthermore, the Air Force placed him in a position to speak for the service on nuclear issues as the government moved to develop the Massive Retaliation strategy. As commander of Fifth Air Force, Everest learned the biggest lesson, speed equated to survivability.¹⁸ This issue would return time after time during Air Force development of the TFX. The lessons of Korea ingrained into the leadership that only the fastest aircraft ensured survivability and therefore the best nuclear delivery capability. Finally, as the

USAFE Commander, Everest was able to see the deficiencies of the F-105 that he could fix with a new “state of the art” Air Force fighter. Tactical Air Command and Air Force Chief of Staff Thomas White identified Europe as their main focus for the F-105 follow-on and Everest began to layout all of his requirements based on this emphasis.

First, he wanted an aircraft that could takeoff on a short, unimproved runway. The 10,500-foot requirement of the F-105 was one of its primary drawbacks. Everest had 94 overseas bases with runways in Europe. Of these, only eleven were good quality. Another 33 were middle quality, but the F-105 was not able to launch and recover from these degraded runways. The remaining 50 runways were considered unusable and of poor construction quality.¹⁹ Everest considered trying to build secret airfields capable of handling the F-105, but it quickly became apparent that this would be impossible without Soviet agents finding out about them and undermining their purpose. The best solution to Everest was to develop an aircraft that could do one of two things: fly transatlantic without refueling and still hit its target, or takeoff from a semi-prepared field in a much shorter distance than the F-105. In the end, Everest pushed for an aircraft that could do both. The problem that he faced was that the technology for such an aircraft did not exist in 1959.

A second issue for Everest was speed. The F-105 could fly in sustained Mach 1.0+ speeds at high altitude, but he wanted an aircraft that was much, much faster.²⁰ Everest developed a requirement for the new fighter to reach speeds of Mach 2.5 at high altitude and a high subsonic speed of Mach 0.9 for what was known as a Dash mission (flying low-level at top speeds to avoid detection).²¹ This requirement was driven by the reigning Tactical Air Command philosophy for nuclear engagement. Radar was still in

development and could be defeated by flying low and avoiding detection through terrain masking, thus ensuring delivery of the nuclear package. This action also reduced the chances that enemy fighters would be able to locate or engage an incoming fighter-bomber. It was impossible to miss the detonation of a nuclear device. The fighter-bomber would need to climb quickly to high altitude, use its superior speed to fight off any enemy engagements and egress the area. Tactical Air Command, General White and General Everest were all heavily invested in this philosophy of nuclear delivery known as Low-Low-High: low level dash ingress, low altitude nuclear delivery and high altitude recovery.²² Any future fighter would need to meet these strict requirements.

Tactical Air Command quickly published their five requirements for a new fighter. The airframe must carry nuclear weapons internally. It had to be able to fly transatlantic without refueling and operate from semi-prepared fields in Europe. Finally, it must reach Mach 2.5 for fighter engagements at altitude and travel at high sub-sonic speeds at sea level.²³ Though many of these requirements represented technological challenges, most were very similar to the already operational F-105 and the Air Force continued to try and find ways to modify this list. The only problem was that the technology for this aircraft did not exist.

General Everest did not have to wait long for a solution. John Stack, the assistant director of the Langley Research Center (a sub-agency of NASA), approached Everest with a concept for a revolutionary change in aircraft design: a variable swept-wing fighter. Everest was very interested in what Stack had to say. The barrier to Tactical Air Command's aircraft requirements was one of polarity. In order to have supersonic capabilities, an aircraft must have very low drag and high thrust. The aerodynamic

properties of an aircraft at Mach 2.5 required a swept wing design that allowed for very little surface area and parasitic drag.²⁴ The major drawback to this type of flight is that it is very fuel inefficient and has poor lift capabilities at slower speeds.²⁵ An efficient aircraft design for Mach 2.5 would never have an unrefueled transatlantic capability or be able to take off from a short, semi-prepared runway; it was simply a matter of lift coefficients. A transatlantic flight aircraft required a large wingspan positioned nearly perpendicular to the wind flow.²⁶ Everest needed an aircraft that was capable of both these capabilities, but they were at scientific odds with one another. Stack's proposal for a variable swept wing aircraft was not a new concept, but it was the first that solved a very serious engineering problem that had stumped aircraft designers up to this point.

The problem with swept wing aircraft was as the wings moved in or out, the aircraft's center of gravity was altered forward or backward. The shift resulted in disastrous changes to the angle of attack to the wings and the lift necessary to keep the airplane in the air.²⁷ Stack's concept involved a new step. The pivot point for the wings was not at the base of the aircraft fuselage, but further out along the wings past the engines. With more lateral separation from the basic airframe, the center of gravity issue disappeared and made swept wing aircraft theoretically possible.²⁸ Stack also discussed development changes with Everest about revolutionary engines and metal structures that could handle the increased strain required of a F-105 follow-on.²⁹ Everest finally had his plane and wasted no time in getting Air Force approval.

In February 1960, General Everest approached Headquarters Air Force and convinced them to approve a new Century Series Tactical Aircraft and issued a System Development Requirement.³⁰ Calling it a tactical aircraft was ultimately a strategic

decision. Up to this point, the Air Force designated aircraft as fighters or bombers. Designating the new aircraft tactical left it open to interpretation as to what capabilities it should possess. That ambiguity was exactly what Tactical Air Command was aiming for and what caused problems as the requirements continually changed.³¹ This very lack of requirements would become a major point of contention with the Navy.

By April, the Air Force hosted a conference for Tactical Air Command, NASA and the Air Force Air Research and Development Command to discuss the System Development Requirement issued by Air Force Headquarters.³² The requirement was approved by all agencies. The new program would cost \$2.2 billion overall, including \$338 million for sixteen test aircraft. The first test flight would be in May 1963, with the first operational aircraft in service by October 1965.³³ There was very little analysis conducted during this conference as to what trade-offs the Air Force was giving up to conduct this tactical nuclear mission. A swept wing aircraft would have many deficiencies over conventional fighters in the area of maneuverability, thrust and air-to-air fighting capability. All of these were deemed conventional battle issues that would have very little impact on the way that future wars would be fought. The conference concluded that revolutionary technological advancements and greater high-altitude airspeed would make this a superior air fighter.³⁴ This aircraft would have one mission, and as designed, little flexibility in that role. The DDR&E gave verbal consent to Tactical Air Command after a short feasibility study was conducted, resulting in Air Force senior leadership praise regarding the quick nature of development.³⁵ Boeing, who wished to start initial development on possible Air Force requirements, contacted Everest and NASA. General Everest passed them the conference results and Boeing immediately

started to develop a suitable F-105 replacement based on the NASA projections.³⁶

Everest had everything working, however, federal cuts in Navy aircraft programs started to worry him.

General Everest and Air Force Chief of Staff Thomas White began to rely on its speed capabilities as a way to make this new aircraft more appealing. The F-105 had only been operational for two years and Congressional budgets were tight. The Air Force was not the only agency asking for aircraft development and the Air Force airframe request must demonstrate a marked difference from the F-105 to justify the expenditure.

President Eisenhower had just directed the Navy to develop a simpler airframe for their new fleet defense aircraft. Everest became adamant on a low-level supersonic dash capability of Mach 1.2 for a distance of 400 miles at sea level in order to set the plane apart.³⁷ This was the genesis of a problem that drove the biggest design issue throughout the life of the TFX. Test studies showed that aircraft in a subsonic dash and a supersonic Mach 1.2 dash have similar survivability, but the Air Force became completely focused on this supersonic sea-level dash speed.³⁸ Everest was convinced that not only was this capability critical to differentiating the TFX from the F-105, but that it would ultimately save lives.³⁹

After the April conference, General Everest officially raised the requirement for the dash speed from Mach 0.9 to 1.2.⁴⁰ This change was not coordinated with NASA engineers or John Stack. Instead, the Air Force continued with the approval process, ultimately filing Specific Operational Requirement #183 (SOR-183) in July 1960.⁴¹ This action committed the Air Force to development of the TFX. As it was published, NASA found out about the new supersonic sea-level requirement and quickly contacted General

Everest to let him know that NASA engineers never studied this capability. This new supersonic dash capability required changes to weight and range scales.⁴² General Everest did not pass this information up his chain of command, but rather had his own engineers look at the problem. They ultimately confirmed NASA calculations, but Everest still did not pass up the information; another problem had already occurred.⁴³

1960 was an election year and Dwight Eisenhower a lame-duck president. Vice President Richard Nixon and Senator John F. Kennedy (D-MA) were both running on campaigns of change and commitment to deal with the Cold War. Eisenhower had already delayed the Navy fleet defense replacement aircraft and he became worried about the costs associated with yet another Air Force aircraft.⁴⁴ DDR&E approached Eisenhower with the idea of combining future Air Force, Army and Navy requirements for aircraft development since the Army continued to build their own tactical aircraft until after the Johnson-McConnell agreement of 1966.⁴⁵ Eisenhower was not comfortable with saddling his successor with any decision, so he placed the Air Force tactical fighter program on hold until the new administration had a chance to review it. On 8 November 1960, John F. Kennedy won the presidency in one of the closest elections in 100 years.⁴⁶

The civilian leadership overseeing the Air Force changed literally overnight. President Kennedy selected Robert S. McNamara as his new Secretary of Defense. McNamara immediately recommended Eugene M. Zuckert as the new Secretary of the Air Force.⁴⁷ All three of these men met and made drastic new decisions about the future of the Air Force and the military in general. President Kennedy was very concerned about the nuclear focus of the national security policy. With the help of McNamara and Zuckert, he wanted to demonstrate two major changes. The first was that Massive

Retaliation was no longer a viable policy. The United States had lost the ability to conduct conventional warfare and needed to balance its capabilities through a new vision: Flexible Response.⁴⁸ The second was that the military had become too controlling in its philosophies and they should return to civilian led control. McNamara and Zuckert ran the Air Force, but not the generals.⁴⁹

Secretary of Defense McNamara wasted no time in trying to figure out the number of competing requirements from all four services. His background made him focus on ways to make the military more efficient and fiscally responsible as he had done during his career at the Ford Motor Company. In January 1961, all four services requested a new aircraft design. McNamara immediately convened a special “Limited War Panel” and gave them three weeks to come up with recommended changes to the military structure and weapons acquisitions that supported the President's new Flexible Response policy.⁵⁰ A key member of this panel was DDR&E, who has been proposing for two years that airframes could be developed jointly. Not surprisingly, the Limited War Panel returned with several recommendations to McNamara, one of which drastically affected the Air Force's plans.

The recommendation was to make changes to the current F-105 design. This included adding rails for additional conventional weapons and converting its doctrinal use within Tactical Air Command. The F-105 would retain its nuclear delivery capability, but the immediate focus should shift to non-nuclear capabilities. This undermined work already completed by the Air Force and destabilized its core belief that nuclear weapons were the future of warfare. Non-nuclear development options were simply not important to the leading Air Force generals.

A second, more serious recommendation from the Limited War Panel affected the Air Force's strategy. On 14 February 1961, McNamara announced that all four services would enter into a Joint Aircraft Acquisition Program.⁵¹ After reviewing the aircraft designs and taking into consideration the recommendations of the Limited War Panel and DDR&E, he mandated that all four services would use the Air Force design as outlined in SOR-183. The document was a mere four pages long at that time, laying out the aircraft design requirements in the most rudimentary fashion. The new program became the TFX and it would be the primary new technologically advanced “do-everything” jet of the future. It would provide tactical as well as limited war options, conduct fleet defense and provide advanced close air support to the Army and Marine forces. McNamara exerted civilian control and ended duplication in military procurement in one mighty swoop. DDR&E Director Herbert York would coordinate the requirements from each of the services in order to design the technical development plan.⁵²

The Air Force was the least affected by this decision, but it was still a serious blow to the stability of weapons procurement and service identity. The Air Force had spent the last fourteen years developing a comprehensive plan for Massive Retaliation. This was the war of the future, everything pointed to this fact in the eyes of Air Force Leaders. Generals Curtis Lemay, White and Everest were the foremost experts on this future of warfare and felt that to prepare for anything less was gambling with national security. Though the United States and USSR had maintained a tenuous nuclear test ban for two years, it was unlikely to hold. Partner nations relied on the US Air Force to provide missile and aircraft nuclear defense against the growing Soviet military machine. Taking the offensive against McNamara, an Air Force general (it was never discovered

who) leaked a memo from the new Secretary of State, Dean Rusk, to McNamara that outlined the United States' new focus on non-nuclear capabilities.⁵³ The leak was intended to convince Congress and European nations that their defense was at stake; if a large enough response came about, then the new McNamara policies could be defeated before they were ever initiated. Though it caused a stir, the response was not enough to change policy.

Beyond policy, the services were upset at the unilateral approach to aircraft development. This was new to the modern era – never before were all four services asked to develop such a sophisticated weapon system that met all of their needs. Not even modern rifles were designed with all four services giving input prior to production. The only effective crossover weapons were those designed by one service and later adopted by another. This collective approach worried each service that it would affect its ability to be seen as an individual service that had distinct and unduplicated capability. Duplication, to military generals, meant their service could be reduced or eliminated during lean economic times. This also meant they would likely have to compromise for an aircraft that had less capability than they wanted.

The Air Force had tied its hands in this situation. Though their TFX design was built around the nuclear delivery capability, the Air Force advertised the aircraft as a technological leap and a multi-mission aircraft. McNamara liked the multi-mission aspect of the aircraft, and it was this facet of the airplane that made him choose that design.⁵⁴ The variable swept wings would allow it to fly for long periods in subsonic speeds and satisfy the close air support and fleet defense missions. The supersonic capability would make it a good interceptor for the Navy and satisfy the nuclear missions of the Air Force.

But most importantly, calling it a multi-mission aircraft fit perfectly into the concept of Flexible Response.⁵⁵ In the Air Force's eyes, the TFX was designed really for one mission, but saying it was designed for multiple missions made it more likely to gain approval. Any design changes to amplify close air support or naval operations would drastically imperil the nuclear mission.

The Air Force knew that the other services opposed the plan as much as they did. For example, the Assistant Secretary of the Navy for Research and Development, Dr. James Wakelin, opposed the McNamara decision with an official memorandum on 9 March 1961.⁵⁶ This letter reflected Navy, Marine and Army displeasure with the multi-service selection of a multi-mission aircraft. Director York agreed with the arguments enough to stand-up the Committee on Tactical Air, a group that met from March until May 1961 on the issue of the TFX. In the end, the Air Force had another victory as the close air support mission was removed into a separate project called the VAX (Attack Aircraft, Experimental).⁵⁷ The Army and Marines were removed from the TFX and only the Navy remained. Now was the time to make another case to McNamara.

General Everest expressed his needs in a technical manner. The Air Force TFX vision was a long-range interdiction aircraft. To accomplish this mission it would have to fly long distances at altitude until it approached the target, where it would drop to low-level and fly at Mach 1.2 for a period of 30 minutes (approximately 400 miles). Once the target was destroyed, it would go back to high level (above 30,000 feet) to return home. The ferry mission would require a large amount of fuel. The low-level supersonic mission would require a heavy frame that could withstand buffeting. And all of these missions would require a long, thin aircraft that supersonic flight demanded.⁵⁸ Generals Everest

and White argued that the Navy designs would focus on a lighter, shorter aircraft that would undermine all of these capabilities. The Air Force engineers expected an aircraft that was 80,000 pounds and over 85 feet long.⁵⁹ Performance standards would be compromised in the name of any naval requirements. The Air Force was correct on this point.

On 19 May 1961, the Committee on Tactical Air gave their recommendation to the Secretary of Defense in a report called "Project 34."⁶⁰ On 31 May, Secretary of the Navy John Connally sent a memorandum to McNamara agreeing to the concept of bi-service development of the TFX. He requested control of the process in order to ensure that the new aircraft would be suitable for Navy standards and carrier deck operations.⁶¹ His request was ignored. On 7 June, Secretary McNamara authorized Secretary of the Air Force Zuckert to develop the TFX with the Air Force taking lead in project development. The only stipulation was that the Air Force should work closely with the Navy to develop a coordinated work statement.⁶²

McNamara's utopian view of the services working together in project development immediately encountered a stalemate. The Navy insisted that the aircraft not exceed 56 feet and 50,000 pounds takeoff weight.⁶³ This constituted an aircraft that was only 55 percent the weight of the one the Air Force envisioned. On 30 June 1961, the Air Force changed its leadership when General Curtis E. LeMay took over as the new Air Force Chief of Staff. LeMay's background in strategic bombers and knowledge of strategic warfare influenced his decision-making. Having built the Strategic Air Command and America's bombing capabilities basically from the ground up following World War II, he was one of the most powerful generals on active duty. He was the

youngest person since Ulysses S. Grant to become a four star general (44) and had been one for over ten years when he became the Chief of Staff.⁶⁴ Lemay did not care for fighter jets and considered them a fancy, fun thing to do while the bombers carried out the true Air Force responsibilities.⁶⁵ He was firmly in favor of maintaining the bomber capabilities of the new TFX and was not known for compromise.

By 22 August, Secretaries Zuckert and Connally reported to McNamara that the services had reached a stalemate. Neither was willing to compromise on their requirements for the new TFX.⁶⁶ The Air Force had no reason to do so; they were the lead service and hoped that the Navy insistence on unbending requirements would result in them getting their own program. After all, Lemay noted that McNamara had already bent once with the VAX program and might be willing to do so again once he saw that the two programs were incompatible. To complicate things further, the Air Force SOR-183 document swelled from a four page document to one almost 250 pages long as the Air Force had laid out their intentions into the work statement.⁶⁷ McNamara was unwilling to bend and he was under a self imposed deadline.

He directed DDR&E to establish the requirements for the TFX to be a joint development and gave the organization only a few days to compile recommendations. They were to take the SOR-183 from the Air Force and incorporate Navy inputs and requirements. DDR&E ended up negotiating directly with General LeMay and Admiral Russell, vice chief of Naval Operations.⁶⁸ Within a week, McNamara issued the *Memorandum of September 1* to the service secretaries. It specified the maximum length, the maximum weight and minimum ordinance carrying capability. McNamara also added his own personal requirement to meet Flexible Response – that the aircraft should be able

to carry 10,000 pounds of conventional munitions. Beyond these changes, his memorandum mandated that, “changes to the Air Force tactical version of the basic aircraft to achieve the navy mission shall be held to a minimum.”⁶⁹

The Air Force now had most of what it wanted. It was lead for project development of TFX and the Secretary of Defense took SOR-183 as the base requirements document. This was important for several reasons. SOR-183 was never modified to represent a multi-mission aircraft beyond McNamara’s and the Navy requirements. At its core, the TFX was still the tactical bomber Everest and White envisioned two years earlier. The Air Force had no reason to truly try to develop an aircraft that was capable of anything beyond their original vision. In fact, with the Secretary of Defense’s memorandum, any changes to this design were to be minimal. The requirements in SOR-183 moved forward to the aircraft industry on 1 October, in a request for proposals that would be due back by 1 December.⁷⁰ However, one major problem existed with the document sent to the contractors: none of the requirements were prioritized.⁷¹ These technical disagreements between the Navy and Air Force represented a struggle to preserve separate and distinct missions that formed the very core of their service’s autonomous identity. The Air Force and Navy never prioritized their requirements, even from the individual services’ perspectives.⁷² This left it up to the aircraft industry to decide.

This normally might have left the Air Force more willing to compromise on the design, but McNamara upped the stakes for the Air Force again in November, after the TFX proposal was already out for design. He cancelled the Republic F-105 Thunderchief project years before it reached the 1,500 originally ordered.⁷³ He then mandated that the

Air Force pickup the Navy F-4 Phantom II as its new air superiority fighter. This had a dual affect on the Air Force. Fighter test pilots quickly pointed out that this jet was a very capable aircraft and would help with air-to-air missions, but not with the nuclear mission.⁷⁴ The F-4 was a very capable Navy jet that had already seen a few years of service and McNamara wanted to prove that an aircraft could meet both services' needs. The problem with this logic was that moving the F-4 to the Air Force led to the Air Force procuring a finished airframe rather than developing a new one. The Air Force needs for the F-4 were never specified in a requirements document, so it never failed to meet any of their expectations. It was a known quantity upon procurement and fit in based on actual performance rather than trying to fulfill a stated requirement. This was not the case with the TFX, the sole remaining airframe to execute the nuclear delivery mission that Tactical Air Command and Air Force senior leaders believed was vital to national security.

As the Navy and Air Force entered into the first ever joint service aircraft bid, more issues emerged. None of the bidders had ever accomplished a joint service development effort. This, combined with the technological leap required, unknown aerodynamic qualities, lack of priorities on the requirements and known service rivalries caused each of the project bid companies significant trouble.

The Air Force process for selecting an aircraft usually ended with the Secretary of the Air Force making the final decision. But since this was a joint development, McNamara would make the final decision. Additionally, the services would use the Air Force selection process, different from the Navy's, to determine the winning design. Proposal analysis began with the Air Force Evaluation Team, followed by the Air Force Source Selection Board, which had both Air Force generals and Navy admirals.⁷⁵ The

information and recommendations of these two boards would then go through two filters of review and recommendation of strategic major command commanders and an Air Force Council made up of both services. Finally, the Air Force Chief of Staff and Chief of Naval Operations would make separate recommendations to their service secretaries. It ultimately took four rounds of bidding and reviews for the secretaries to finally make a recommendation to McNamara on an aircraft.⁷⁶

The Air Force preferred Boeing's design from the beginning. The Air Force liked everything about the design of the aircraft; it was everything they wanted in a fighter-bomber. Boeing had approached General Everest and John Stack of NASA to discuss this very aircraft in 1959.⁷⁷ Once design came about, they had been working with the Air Force unofficially for two years to develop the aircraft they wanted. They made only one serious error - the engine. Working with General Electric, Boeing had a design for a new engine on the books called the MF-295. It was smaller than rival engines, with more stability and much more power.⁷⁸ Boeing gambled by adding it as their primary engine, allowing the structure to be smaller (not needing to support a larger engine) and still meet both the Air Force and Navy requirements. The problem was that it was only a theoretical paper engine; no operational or even prospective engines had yet been built.⁷⁹ The Air Force had a lot of experience with engine development and knew that an operational engine would take at least three years and would put the project behind schedule by two years. The General Dynamics aircraft was also flawed as it failed to meet the Navy or Air Force specified requirements. The Navy felt that it was not compatible with an aircraft carrier, although the one advantage it had was that it used the Navy developed Pratt-Whitney TF-30 engine as its source of power.⁸⁰

Ultimately, on the first round of selections, the Evaluation Board ruled that none of the six aircraft submitted were acceptable.⁸¹ However, the General Dynamics and Boeing aircraft showed enough promise to recommend a second paid-round of development. Boeing would incorporate the TF-30 engine into their design and General Dynamics would need to meet the Navy requirements. The Source Selection Board disagreed with the findings of the Evaluation Board. They recommended issuing the award to Boeing right away in order to immediately enter into the development phase. This is where source selection process for the Air Force and Navy differed.

The Air Force usually selected the company that showed the most promise and capability with only one round of bidding. This eliminated money being spent repeatedly for competing proposals that were not directly influenced in initial development. This method reduced costs, and eliminated time spent on numerous run-offs. The Air Force knew there was a Secretary of Defense imposed deadline and each delay ate into that production schedule. The Air Force Council disagreed with the Source Selection Board and went with the recommendations of the Evaluation Board. They felt that it would be impossible to justify to civilian leadership selecting Boeing if they then had to redesign the aircraft completely based on the engines. The service secretaries agreed and a second competition was authorized on 31 January 1962.⁸² The two companies had until 2 April to develop new ideas.

The second round turned out much better for both companies. The Air Force unanimously agreed that the Boeing design was superior to the General Dynamics version. The Navy agreed that the Boeing version was better, but would not agree to support the Boeing design. The design still did not meet Navy requirements and they

would simply not support an aircraft that did not meet design minimums before development. The Air Force source selection focused on selecting a source rather than a finished design, which could be worked out with the company chosen. The Navy, violently opposed to this process, exercised a veto, claiming that neither the Boeing nor the General Dynamics designs were acceptable to the Navy. Admiral Pirie, deputy Chief of Naval Operations, contacted General LeMay and convinced him that more attention be given to the Navy requirements.⁸³ Each general contacted their respective service secretary and requested that Boeing and General Dynamics create two different service specific versions. After several weeks of thought and running it through his own staff, Secretary of Defense McNamara authorized a third competition where the two companies could have two divergent designs. However, he emphasized that this divergence should be kept to an absolute minimum.⁸⁴ Each company was given only a few days to submit their next design.

Though the Air Force heavily favored the Boeing joint design, the prospect of another design competition was very appealing. It was happy with the current design and knew that any divergence would likely occur on the Navy version, something that would not affect the design they the Air Force was already willing to accept. A divergence would only encourage the Navy to approve the aircraft. Unfortunately for both services, the companies were given only a few days. McNamara authorized the third design competition on 9 June 1962, and the designs were due to the Evaluation Group on 15 June. Additionally, the Evaluation Group was only given five days to analyze the results of this change.⁸⁵

The Evaluation Group recommended the Boeing aircraft, as did the Source Selection Board. Boeing had increased some the wing area on both their designs and had a substantially different Navy version that met carrier requirements.⁸⁶ The General Dynamics Air Force version remained the same as before, so it did nothing to convince the Air Force members of the board to select this version over the Boeing design. The only concern to the Air Force was whether the Navy would accept Boeing's new design. The boards all agreed with selecting Boeing as the sole source all the way up through the Chiefs of Staff.⁸⁷ The Navy had finally agreed to allow design to follow source selection, but they were concerned with the testing on the designs.

Secretary of the Navy Korth and Secretary of the Air Force Zuckert contacted each other and took in the inputs of the service chiefs. The both agreed that not enough testing was accomplished due to the short period that the companies had to put forth their designs.⁸⁸ Not only had the companies not been able to do any wind tunnel testing, the services had not had the time to confirm any of their claims. The period of this design proposal was too short. Secretary Zuckert changed General LeMay's recommendation for awarding Boeing the sole design to a fourth competition between both companies, giving them much more time to design and also for the services to evaluate. Secretary Korth recommended the same from the Navy side. Secretary McNamara listened to the two secretaries and authorized a fourth competition, beginning on July 1.⁸⁹

After three competitions and a looming deadline of starting production, there was additional pressure to ensure that this was the last competition. Secretary Zuckert convinced McNamara to allow an unusual step in a design competition. Zuckert authorized Colonel Charles Gayle, head of the Evaluation Group, to work with each

contractor as if they had already won the design competition.⁹⁰ The Air Force wanted to ensure that this was the last competition so that they could start production as soon as possible. Gayle spent the next several months working with both companies, giving them direct suggestions on correcting deficiencies and on materials used. During this fourth competition, McNamara wrote a letter to the presidents of Boeing, Grumman and General Dynamics (Grumman was a General Dynamics partner), and outlined his conditions for award of contract.⁹¹ The Evaluation Board, Selection Board and Service Chiefs did not receive the same letter.

On 11 September 1962, both companies turned in their final proposals.⁹² Over the next month, the boards thoroughly reviewed the proposal. All boards from the Evaluation Group up to General LeMay and Admiral Anderson unanimously agreed that the Boeing design better met their needs. Not only was it the superior design to each one of the services, it was also cheaper. General LeMay had made 23 source recommendations in his career as the Chief of Staff of the Air Force and the Secretary had accepted every one of them without question. Concerned about getting McNamara's agreement, LeMay included a variety of reasons that he preferred the Boeing design in his recommendation on 8 November.⁹³

First, the Boeing design had the widest amount of design difference between the Air Force and Navy proposal. This appealed to the Air Force since it offered the best promise of obtaining the unrestricted version it originally sought with SOR-183. The scores issued by the Selection Review Board were almost identical between the overall General Dynamics and Boeing designs, but the Boeing design scored significantly higher on the performance section. General Dynamics had picked up points in the technical and

management sections.⁹⁴ The Air Force and the selection board placed more emphasis on the performance aspects of this competition and selected appropriately. General LeMay also noted two additional features on this aircraft that set it apart from General Dynamics version. The Boeing design had included thrust reversers as part of the engine design.⁹⁵ This was the first combat use of thrust reverser and this capability would replace the speed brake as a way of slowing down the aircraft. Lemay was especially interested in the fact that it could be used in flight, possibly giving fighter pilots an advantage in air-to-air battles. The second variation was another design difference with the engines. The Boeing aircraft had mounted the engines on the top of the wings.⁹⁶ This provided two possible significant advantages. The first was it reduced the likelihood of Foreign Object Damage (FOD) to the engines during takeoff from semi-prepared fields. A rock or twig would have much more trouble getting into the engine if it were located on top of the wing. Additionally, a known problem at the time in fighter aircraft was that engines sometimes flamed out if a missile launched too close to the engine inlet area.⁹⁷ The disturbance of airflow and the rocket ignition could cause compressor stalls or complete engine failure. The high engine would eliminate this problem. While the Navy had no objections to either airframe and selected the Boeing aircraft simply because it was the one the Air Force wanted, General Lemay had another reason to want the Boeing aircraft immediately for nuclear missions.

On 14 October 1962, a U-2 surveillance aircraft captured photographic evidence that the Soviet Union was building a secret military base in Cuba. LeMay continually encouraged Secretary McNamara and President Kennedy to use military force against the Russian equipment in Cuba and was an open dissenter of the naval blockade. He believed

that the United States should surround the island and bomb it with air assets. When the administration ignored these ideas, he took offense. He later commented that the political solution to the problem was, “the greatest defeat in our history.”⁹⁸ It only got worse when he learned of a secret agreement between President Kennedy and Premier Nikita Khrushchev. In exchange for removing the Soviet missiles out of Cuba, the United States would slowly remove all of the Jupiter and Thor medium range ballistic missiles from Europe and Turkey over the next year.⁹⁹ Kennedy planned on following through and this meant General LeMay would lose all of his European ballistic missile capabilities. He needed something immediately to fill the new capability gap negotiated by the President. The Soviets were still pulling their equipment out of Cuba on 8 November 1962, when Lemay decided the Boeing TFX was his solution.

Following a breakfast meeting between Secretary Zuckert, McNamara and Assistant Secretary of the Navy Dr. Wakelin on 13 November, General LeMay and General Walter C. Sweeney (the new Tactical Air Command Commander) found out that the contract was awarded to General Dynamics for production of the F-111 (the designation given to the TFX aircraft). On 24 November, the Department of Defense made a public announcement that the General Dynamics version was selected and that they would develop 22 prototype F-111's for a cost of \$439 Million.¹⁰⁰ The Air Force was forced to accept an aircraft they felt was inferior. They also felt forced to accept a lighter, slower, smaller and generally less versatile aircraft in order to appease the Navy and Secretary McNamara. General Lemay and all of the other Air Force generals were crushed by the decision, but production was to begin immediately.

In December, the Air Force stood up the Special Project Office to deal with the development of the new F-111. The Special Project Office stood up a 250-man program at Scott (Wright-Patterson) Air Force Base, Dayton, Ohio.¹⁰¹ The Air Force would allow the Navy to send as many officers as they wanted, but the Navy only sent a small contingent from the Bureau of Weapons, constituting only about 10 percent of the officers making up the Special Project Office. The Navy chose to keep the majority of their officers at their Navy location just outside of Washington, DC.¹⁰² The Air Force led development of the airframe and the engines, while the Navy focused on designing the Phoenix missile systems. Although project design was almost complete and the selection process was over, the Air Force and Navy would continue to fight over development issues for the next year.

The Air Force hoped for a coming change in the atmosphere within the Department of Defense to help with their stance. Since the inception of the Department of Defense, the average life span for a Secretary of Defense was less than two years. McNamara was already approaching that length of time and General LeMay hoped a new secretary would be appointed soon. However, that reprieve never came and McNamara would end up being the longest serving defense secretary in the nation's history at seven years.

General LeMay had been delaying the purchase of F-4's, hoping that they would be able to shift more focus back to nuclear delivery over the conventionally focused fighter. A large purchase order of this Navy fighter was now inevitable that Zuckert and McNamara were pushing conventional aircraft. As the number of F-4's increased, the Special Project Office became more focused on ensuring that the F-111 would be a

nuclear focused aircraft that met only the minimum conventional capability to keep McNamara, Zuckert and the Navy happy. The development team from General Dynamics and Grumman spent most of their time with the Special Project Office (made up mostly of Air Force personnel) and continued to enhance the nuclear mission over the other conventional aspects of the aircraft. This combined with continual Navy demands for additional features that seemed at odds with their own criteria led to increasing divergence on the project.

The Air Force began 1963 feverishly trying to make the new F-111 development proceed quickly, but it was hampered by continual problems and distractions. First, NASA engineers contacted General Dynamics and the Special Project Office to let them know of potential drag issues with the aircraft's mission during the sea-level supersonic dash. The dense air at sea level was causing a disturbance within the boundary layer of air as the aircraft went supersonic and greatly increased the drag. Wind tunnel testing revealed that the proposed General Dynamics production model would not achieve the low-level supersonic capability. These were ultimately the very same issues John Stack raised two years earlier to General Everest, but the Tactical Air Command general never forwarded the reports to his superiors or the development teams at General Dynamics. The Air Force now had a decision to make.

If the Air Force cut the supersonic portion of the aircraft at sea level, it would drastically change the nature of the aircraft's development. A vast majority of the design and weight of the aircraft centered on this particular capability. To compromise on this one aspect of it would allow almost every other aspect of the aircraft to come in line with their requirements of a multi-mission aircraft. However, General LeMay was concerned

with the nuclear delivery capability and refused to allow this dash mission to be dropped from the requirements list. Nuclear missiles were being pulled every day from USAFE bases and he felt this supersonic dash ability was vital to maintaining the nuclear power of the United States. The supersonic dash mission remained a key requirement highlighted from the Air Force Chief of Staff to the engineers at General Dynamics.

At almost the same time as the drag issue arose, a more influential political problem also came about. Due to the outcry by the military generals and admirals from the Air Force and Navy over the selection process, Congress became involved. Hearings were initiated by the Senate Permanent Subcommittee on Investigations of the Committee on Government Operations under the chairmanship of Senator John McClellan (D-AR).¹⁰³ The committee's purpose was to determine if the awarding of the F-111 contract to General Dynamics was politically motivated. Though the Air Force had little involvement in the hearings, the Senate hearings did have a serious effect on the Special Project Office and everyone at General Dynamics. There was real fear that the contract may be invalidated at any minute. However, with Secretary McNamara publicly defending the selection process and his final decision, he became more entrenched and involved in development decisions.

On 1 September, General Dynamics completed the first mock-up for production. The F-111 was finally designed and ready for the first production models to be built for flight-testing. The Air Force requested the drawings through the Special Project Office for their own engineers to take a look, but through a technicality in the awards document, General Dynamics was not required to deliver schematics until the first aircraft was

released for flight testing. General Dynamics never delivered the schematics until the day the contract required, despite repeated requests by the Special Project Office and NASA.

These requests became a bigger issue as production continued to move into 1964. Dr. Alexander Flax, assistant Secretary of the Air Force for Research and Development, became aware of the drag issues from the Special Project Office and NASA.¹⁰⁴ He now faced a dilemma. The General Dynamics testing in wind tunnels was showing optimistic results to the supersonic requirements, but similar NASA theories on wind tunnel tests were showing a very different story. He expected the General Dynamics results to be optimistic, but the NASA results were not necessarily accurate either as they were based on the data inputs provided by General Dynamics.¹⁰⁵ Resolving the lack of independent testing in wind tunnels would put another six-month delay on the program. Secretary McNamara and Zuckert were both committed to staying on time. Even as Navy objections to the weight increases threatened to derail joint development, McNamara continued to push for the time line to stay on schedule. Because of this effort, assembly began on the first F-111 in June, with a projected test flight in December 1964.¹⁰⁶

As development continued, numerous technological challenges confronted the Special Project Office, General Dynamics and Grumman. Many of these problems centered on changes that the Navy wanted to control weight increases that affected both versions of the aircraft. However, most changes were never made as consensus was never obtained between the Special Project Office and Navy Bureau of Weapons.¹⁰⁷ A large part of this was due to location. No face-to-face meetings were ever initiated because the Navy office was in Washington, DC and the Special Project Office was in Ohio. Instead, official memos were sent back and forth until it was too late to make a change in the

production line since General Dynamics already constructed the parts. In addition, the Special Project Office continued to focus mainly on problems that would affect the nuclear mission rather than the conventional uses. One such example was the engine. It became apparent early in 1964 that the thrust-to-weight ratio would be very small in this aircraft, something that fighter pilots rely on for conventional delivery and for air-to-air conflicts. However, thrust-to-weight ratio was not truly addressed as an issue for the aircraft for several years as an engine redesign would take several months, if not years, to perfect.

The first test flight of the prototype F-111A (Air Force Version) was conducted on schedule in December 1964.¹⁰⁸ In a telling prediction, the first flight was delayed because of an engine compressor stall on the ground. In subsequent flights, the test pilots discovered a serious engine problem.¹⁰⁹ The engine inlets were not creating the right kind of airflow into the turbo-fan engines and were causing engine compressor stalls. Testing revealed that the air flowing through the engine inlet was turbulent and that the new engines were overly sensitive to this disruption, causing them to produce limited power or shut down altogether.¹¹⁰ This problem became so serious that the test pilots were restricted from supersonic flight until an engineering response could be formulated.¹¹¹ The engines were the main drawback to the aircraft, while, ironically, the technologically advanced variable swept wings worked with almost no problems.

It took over a year to develop all of the test data from the flights. Once again, General Dynamics was not contractually obligated to send all of their flight test data to the Special Project Office or Bureau of Weapons for analysis. During this period, Secretary of the Air Force Zuckert heard only about the successes of the wing design and

nothing of the engine compressor stalls. On 13 April 1965, he wrote a letter to Secretary McNamara telling him of the success of the aircraft.¹¹² He recommended that the DoD sign a contract with General Dynamics so that production could begin immediately. Secretary McNamara agreed and the contract was signed, even though full flight-testing was not yet complete and a F-111B (the Navy Version) did not even exist.¹¹³

In May 1965, the first F-111B was delivered for military testing. The A and B versions had the same engine problems. A Navy evaluation in October of 1965 reported that the aircraft was seriously underpowered and that it was sluggish.¹¹⁴ The report, combined with Air Force data, revealed to the senior leadership the engine problem with stalls. One of the major problems noted was the lack of information flowing between the Navy and Air Force test pilots and management offices. Secretary Zuckert proposed to McNamara that Rear Admiral W.E. Sweeney become the deputy director of the Air Force lead Special Project Office, changing the highest-ranking Naval officer from that of a captain to a two-star flag officer.¹¹⁵ Although the Bureau of Weapons opposed this move, the transition was approved and the two services started to work jointly on the engine inlet issue by the end of 1965. The Air Force had an advocate of the joint program starting on 1 October. Dr. Harold Brown, former director of DDR&E, was appointed the new Secretary of the Air Force.¹¹⁶ This was a deliberate attempt by McNamara to keep the Air Force on the joint development path, as Brown had no Air Force experience other than his duties at DDR&E.

The F-111 program started to fall apart for the Air Force in 1966. The engine problems continued as General Dynamics and Pratt and Whitney examined the issues with the engine inlet. The Air Force tried to determine which company was at fault, but

both agencies had legitimate complaints with the other company over compressor stalls. General Dynamics claimed that Pratt and Whitney was responsible for the engines and had designed the engine inlets in line with Pratt's requirements. Pratt and Whitney claimed that the placement of the engines and the inlet designed by General Dynamics was not giving a consistent airflow needed for the engines as specified in the contract. Neither company was held responsible.¹¹⁷

The lack of fighter capabilities in the F-111 finally became apparent. The Air Force had put a premium on speed and technology in all of their fighter-bomber aircraft, especially the F-100 and F-105. By early 1966, reports started coming in from Vietnam on the performance of these aircraft. The F-100 was so inferior that it was being held to rear-echelons and the F-105 was so susceptible to fighter interdiction and surface to air missiles (SAMs) that they were being shot down at an alarming rate. Ultimately, over half of the F-105s built would be shot down in Vietnam by either MiG fighters or surface to air missiles.¹¹⁸ The poor performance of both these aircraft being used in conventional fights was alarming to the Air Force, but did nothing to change their focus on the nuclear aspects of the F-111 development.

By mid-1966, Secretary McNamara finally became aware of all the problems with the F-111 flight tests and engine failures. He came to the realization that the F-111 was more bomber than fighter and all the Air Force efforts were focused on enhancing the nuclear delivery rather than making it a conventionally strong aircraft for either service.¹¹⁹ Secretary Brown also reported to McNamara that tests revealed the engines were seriously underpowered for the high-drag, high-tonnage aspects of conventional roles for the aircraft.¹²⁰ This combined with Senator McClellan reopening the Permanent

Subcommittee investigation into the F-111 program caused Secretary McNamara to take drastic action. In May, he took control of the program away from the Air Force and Navy, placing all of the responsibility on himself and his staff. Secretaries McNamara and Brown met weekly to discuss the progress of the F-111 in meetings dubbed “Project Icarus” by McNamara himself.¹²¹

Although there were numerous engineering issues being worked by all players involved, the production line never halted. Ever since the first aircraft rolled off the line for flight-testing, General Dynamics had not stopped producing the aircraft.¹²² The Department of Defense had put in the contract for a full purchase over a year earlier. Once the first aircraft rolled off the line and the process was in place, changes to already produced aircraft would be prohibitively expensive. This fact seemed to escape the senior civilian officials involved as they continued to push additional changes on the Air Force. McNamara made comments through the end of 1967 showing that he missed the fact that the F-111 was in full production since 1964.¹²³

Each month the Air Force and General Dynamics continued to work on fixes to the engine inlet system to solve the compressor issue. In June, McNamara initiated a requirement to procure a new avionics system.¹²⁴ This system, called the Mark II, pulled the focus away from nuclear delivery and highlighted his focus on conventional capabilities. Aside from changing the focus of F-111 development, there were several other problems with this decision. The Mark II was not yet fully designed, and it would not be ready for implementation for another year.¹²⁵ Additionally, it required much more space and would not fit into aircraft that were already past a certain point in the production line. The additional weight of the system did not help the Navy requirement

or the underpowered nature of the aircraft.¹²⁶ Just how underpowered was a question that would be soon answered.

In October 1966, flight test data came back to the Air Force. It revealed several deficiencies with the aircraft that would reach McNamara. First, it was the heaviest tactical fighter in operational use. Second, it had the lowest engine thrust relative to the aircraft weight of any supersonic American fighter. Third, it had the highest ratio of aircraft weight to wing area of an operational American fighter, which remains true to the current day.¹²⁷ Tests also revealed that the supersonic dash could be accomplished for only 30 miles due to fuel consumption and engine issues.¹²⁸ This represented less than ten percent than the original contract requirement. Yet, the airplanes still rolled down the production line unhindered.

These facts were enough for Senator McClellan and his subcommittee to put a stop to further development for the Navy version of the F-111.¹²⁹ This halt was only in place for a short period, but it was enough for the Navy to impose a number of new requirements for the F-111B and separate themselves and the Air Force on development. The Air Force never took any steps to slow down production in order to address these issues. This decision resulted in a large number of versions.

In late 1966, the Icarus meetings agreed upon further changes for the Air Force version.¹³⁰ They approved the use of a new more powerful engine to be developed and the design of a new engine inlet system for the aircraft. The new engines would require a redesign that was not compatible with any aircraft that had started production. As a result, 235 of the 437 aircraft ultimately purchased were never given the more powerful engine.¹³¹ The engine inlet solution started with General Dynamics' designed Triple Plow

I and ended with a subsequent design by Air Force engineers in the Special Project Office who produced the Triple Plow II. The Air Force redesign eliminated the stall issue, but was incompatible with 141 of the production aircraft that had already passed that point in production.¹³² The Mark II avionics also finished testing and were implemented into another version a few months later. Finally, Project Icarus recommended a fighter-bomber version of the aircraft that would include extended wings and greater range.¹³³ Within an eighteen-month period, the Air Force moved from one version of the F-111 to five separate versions.¹³⁴

More serious events occurred in late 1967 and 1968. First, Senator McClellan successfully blocked the funds for Navy development of the F-111B for another year. Then in November, McNamara announced his planned departure, retiring in February 1968.¹³⁵ The day after he retired, the Senate hearings leading to cancellation of the Navy F-111 program started. Additionally, feedback from Vietnam on the performance of the first F-111A's in combat was not positive.¹³⁶ It noted that the F-111 acted well as a bomber but had serious deficiencies as a fighter aircraft.¹³⁷ Also, cracks formed in the wing box, years before they should have had problems.¹³⁸ It became more and more obvious to the Air Force that this aircraft could not be used in a multi-role function. The biggest issue for the Air Force was that they planned to use this as their premiere fighter through the 1970s. It was not even a premiere fighter in 1968, so they would need to start procurement on yet another fighter.

In 1968, the Air Force started developing requirements for a new Fighter Experimental (FX) that would ultimately become the F-15. During this period, the Navy started searching for the exact same aircraft. Initially Congress and the new Secretary of

Defense requested that the services attempt another joint acquisition. Although both services initially agreed to this development, both saw the same issues they had just experienced in the F-111 development. The Air Force and Navy both refused to take part in another joint program and sought their own fighters based on the lessons of the F-111.

In the end, the Air Force ended up with 437 F-111's: 141 F-111A (original engine, original inlets), 96 F-111D (Mark II avionics, larger engine, stall tolerant inlet), 94 F-111E (enlarged inlet, original engine, original avionics), 106 F-111F (enlarged inlet, larger engine, post Mark II avionics), 76 FB-111A (stall tolerant inlet, larger engine, upgraded avionics, extended wing tips). The F-111 found a home with the Air Force as an electronic jammer and bomber. The primary mission of the EF-111 and FB-111 became suppression of enemy air defenses, and it flew operationally for over twenty years.¹³⁹

The Air Force did find a way to employ this aircraft. But it never achieved the initial vision of Generals White and Everest. The program cost almost \$9 billion and the Air Force only procured one third of the aircraft it planned on buying. Though cost overruns were common in the 1950s and 1960s, this was the largest of either decade. The concept was for a joint aircraft that met multiple services needs. In the end, the Air Force blamed the Navy for not getting the aircraft it wanted. This impression was right on many levels. However, the Air Force never took the time to understand this same issue from the Navy's perspective.

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CHAPTER 3

THE NAVY PERSPECTIVE

The end of World War II found the US Navy at its highest point since its inception. The Navy operated numerous carriers in multiple theaters. The entire fleet represented 70 percent of the world's total tonnage and total number of ocean-going vessels.¹ At its peak, the US Navy operated 6,768 ships on Victory over Japan Day in 1945.² However, entering into a post-war world was hard for this service which had become accustomed to getting all it needed for over a decade. The age of the battleship was essentially over; the Navy focused entirely on the carrier battle group for its future. This force structure had shown the most promise for power projection during the fight with Japan. Focus turned quickly to the new nuclear capability and fleet defense of the carrier battle group.

Carrier development in the 1950s brought about a need for new types of aircraft. The design of aircraft fit for carrier launching and recovery had been a long and hard-fought battle for Navy engineers. The speed, complexity and size of jets only made things worse. Each aircraft was designed for a specific purpose that drove a special set of requirements for loiter time, speed or ability to transmit sonar and radar signals. Of all these mission sets and newly required aircraft, the one that plagued the Navy the most was fleet defense.

Fleet defense aircraft relied on a set of very special skills. First, the aircraft had to be able to fight against the most sophisticated land-based fighter jets in the world, as the carrier was often sent within range of land air bases. Next, it needed to see the enemy coming from far off, as the early warning detection and interceptor for Navy vessels. Due

to the complexity of launching, the aircraft needed to be able to loiter at different altitudes and distances from the ship in order to fulfill this defense portion of the mission. In addition to loiter time, it had to have speed to reach other in-need aircraft or to intercept inbound aircraft from the enemy. Finally, it would need to be able to accomplish any of these missions in bad weather or low visibility, which is most common in coastal areas.

Chief of Naval Operations Admiral Arleigh Burke focused on consolidating the issues of the naval air power as he had with the submarine fleet. In 1956, development was already underway for the McDonnell Douglas F-4 Phantom II, not to be confused with the F-4D Skyray. Though the F-4 Phantom II interceptor set numerous world records starting in 1958, the Navy immediately started looking for a supplemental replacement fighter aircraft for fleet defense. Experience had shown that any aircraft would only last for a few years as a fleet defense bird and the F-4 was scheduled to take operational effect in 1960.³ The F-4 was a superior fighter aircraft, but it had poor loiter times and needed a tanker and more circuits to provide continuous fleet defense.

The biggest problem with fleet defense was that of early warning. Supersonic aircraft could approach the fleet and not be detected by carrier radar systems until the aircraft was within 100 nautical miles of the ship. If the aircraft was traveling at Mach 2.0 at 35,000 ft (about 1,350 miles per hour), the time between detection and the enemy aircraft arriving at a five mile firing range would be slightly over four minutes.⁴ Any fleet defense aircraft would have to launch, climb up to meet the aggressor and keep it from firing in this short period of time. This was impossible, especially if more than one aircraft were used in the attack. This meant that interceptors needed to stay in the air at all

times and should also have a large detection ring in order to increase the range of the fleet radar systems. The F-4 Phantom II had good interception speed, but it had short loiter times and a constant patrol would require an unsustainable large number of aircraft. Also, its supersonic capabilities precluded a large on-board radar system.

In 1959, the Navy requested development of a new fleet defense aircraft. Advancements in Air-to-Sea missiles worried naval commanders and they wanted an aircraft that could intercept any fighter that would launch such a missile before it got within range of the fleet. This pushed out the ring-of-support line and demanded a new fighter with long air-to-air missile range and a futuristic fire control system.⁵ Although the Navy felt that future fighters needed to be supersonic (like the Air Force), the component demands on the aircraft would cause serious design issues and costs to increase exponentially. However, a subsonic aircraft would be far simpler and costs could be kept much lower. Additionally, it would greatly increase loiter times. Many naval planners believed that future combat might be completely carried out by long range missiles and that air combat would be fought exclusively through complicated systems, eliminating the need for supersonic flight in defensive roles.⁶ Radar systems would become so complex that the pilot could not be expected to fly the aircraft and work all of the systems simultaneously. This required a second dedicated crewmember that became known as a radar intercept officer. Any air-to-air fights could be augmented by the F-4 Phantom II or avoided altogether by utilizing superior technology with radars, fire control systems and advanced missile systems. The Navy and Admiral Burke decide to pursue a subsonic fleet defense interceptor, calling it the F-6D Missileer (not to be confused with

the F-6A, which was the re-designation of the F-4D Skyray).⁷ The new aircraft would need a variety of new capabilities to realize the Navy vision.

First, the Navy wanted an aircraft that could provide approximately six hours of loiter time. The F-6 would incorporate a five-foot radar dish for long distance detection and destruction of enemy aircraft from miles away.⁸ The crew was increased to three and the co-pilot and pilot would share a radar screen to reduce the amount of communication to authenticate enemy fighters and reduce errors. The F-6 would require several new systems as well to make this happen. Admiral Burke and the Navy sold the F-6 program by using clean and simple math. By accepting subsonic capability, the costs were reduced significantly and more than offset those of the new missile and radar technology.

Development was proceeding with the F-6D when the Air Force turned in their requirements listing for the F-105 follow-on. DDR&E then gave a recommendation of consolidation to the administration, seeing an opportunity to stop some of the duplication of technology advancements. In late 1960, the Eisenhower administration unexpectedly halted further development of the Missileer program.

Robert McNamara's Limited War Panel took a look at Navy and Air Force requirements, and recommended the Missileer program be cancelled. In its place, the panel suggested all four services utilize the Air Force F-105 replacement aircraft, now called the TFX. This decision shocked the Navy and, combined with a series of other McNamara choices, made them worry about their very existence. McNamara immediately questioned the value of nuclear propulsion for Navy ships and submarines. This concept was central to the Navy's fleet modernization project. Secretary McNamara also encouraged the movement of all military cargo by air rather than by sea,

undermining the long standing sustainment mission of the Navy. Finally, McNamara immediately increased US Strike Command's size and span of control, giving it control of several hundred Navy ships. Admiral Burke and the rest of the Navy viewed these decisions as moves to undermine the Navy.

The TFX was one more way to marginalize Navy requirements. Admiral Burke had reason to worry about the TFX. The TFX's transatlantic capability and its ability to takeoff from semi-prepared fields to deliver nuclear weapons and project power would reduce the need for carriers and battle groups. Additionally, Secretary of Defense Louis A. Johnson's arguments in 1950 for getting rid of the Marine Corps and Navy centered entirely on the duplication of ability by the Air Force and the other services. With all of the services flying the same aircraft, Admiral Burke foresaw the same argument coming again from a secretary who was obsessed with reducing cost and focused on efficiency. He fought back as hard as possible when the TFX was announced as a four service project.

Admiral Burke's problem was that McNamara pushed for a multi-mission capable aircraft that was at the edge of technological capability. The Missilier project focused on something that was specific to the Navy's needs, but would have little applicability to the other services. McNamara and the Limited War Panel took the multi-mission capabilities of the Air Force proposal as gospel, which could work for everyone without modification. DDR&E was focused on eliminating duplication and reducing the military budget through finding technological leaps that could work for all of the services' air needs. Admiral Burke was not alone in his efforts to resist this option. The Marine Corps and Army resisted, causing the Secretary of Defense to reevaluate his first big decision.

Herbert York, director of DDR&E, convened a committee on tactical aircraft to evaluate the services' concerns.⁹

In May 1961, the Army and Marine Corps were released from the TFX project because close air support missions could not reasonably be supported through a long range, supersonic nuclear fighter/bomber. However, the committee concluded that the naval fleet defense mission could be supported with the TFX. Secretary McNamara immediately cancelled the Missilier aircraft project to ensure the Navy would give full support. Either they would support the aircraft or they would not get a new fleet defense aircraft.

Admiral Burke realized that this co-development was now a reality and immediately shifted his tactics. If there was to be a co-developed aircraft, the Navy needed to lead the design. Only Naval engineers understood the requirements of shipboard operations and the stresses a carrier-based aircraft would require. The recent integration of the F-4 Phantom II into the Air Force inventory was a sign of this successful flow. The Bureau of Naval Weapons (BuWeap) normally had oversight and technical direction of every naval aircraft. Secretary of the Navy John Connally and Admiral Burke made the recommendation for BuWeap to be the lead in this project design as well.

On 7 June, at the recommendation of DDR&E, McNamara announced that the TFX program was approved and that the Air Force would be lead for design. The leaders at BuWeap immediately revolted, sending scathing letters and comments up the chain of command. When the request came from the Special Projects Office (SPO) at the Air Force for manning, the Navy had the right to provide up to 50 percent of the personnel.

However, BuWeap provided less than ten percent of the manning, and no one over the rank of O-6, hoping that keeping all of the higher ranking individuals at BuWeap headquarters in Virginia would allow them greater ability to exert control. These actions only sought to alienate the civilian leadership of the Navy from the Office of the Secretary of Defense. McNamara and Connally had been warned that parochial interests by the services would have to be broken, and BuWeap's constant objections to any issue were soon ignored. Secretaries Connally and Zuckert started working together to eliminate the service objections.

Despite these issues, BuWeap delivered the Navy's initial needs to the TFX special project office. These requirements included a self-contained pilot escape capsule, the ability to carry two phoenix missiles internally, have an increased volume for the phoenix avionics (which weighed 1,900 lbs), ability to loiter at 150 miles for three and a half hours or at 750 miles for one hour, a maximum length of 56 feet and a maximum takeoff weight (with fuel) of 55,000 pounds.¹⁰ Every decision and capability requested by the Navy would drive up weight and aerodynamic drag, causing problems with loiter capability and supersonic needs. The Navy never wanted a supersonic aircraft and their design requirements continued to push their expectations of the scrapped F-6. The requests were so out of context from the Air Force design that it became apparent to DDR&E that the TFX design for the Navy and Air Force could not co-exist.¹¹

In August 1961, the Navy requested to be released from the project once more. McNamara refused and told DDR&E to continue to push forward with Air Force design of the aircraft with only suggestion inputs from the Navy. Feeling marginalized, the final blow to a TFX design led by the Navy BuWeap came with McNamara's 1 September

memorandum.¹² He clearly dictated that the naval influence was to be kept to a minimum and that the Air Force had primary design for the TFX aircraft. Over the next month, the Navy started funneling their requirements to the SPO in Ohio. However, they knew that the next opportunity to be released from joint development was just a few months away with the design competition.

This point in the project was pivotal to Navy acceptance of a joint development. The 1 September memo drove home the idea that McNamara did not care about the Navy or its requirements. BuWeap was accustomed to handling all naval aircraft development and managing the process for aircraft selection. The memo set the maximum length (longer than the Navy wanted), the maximum weight (heavier than the Navy wanted) and the minimum ordinance carrying capability (less than required by the Navy).¹³ DDR&E would resolve any discrepancies between the services, but the direction was clear: any conflicts would go in the favor of the Air Force. The Navy had a long history of making sacrifices and adjustments to their aircraft designs, but these decisions were normally made internally, not externally. This small and subtle difference would ultimately become the downfall of the Navy F-111B.

Both services delivered their specifications by 1 October to the aircraft industry. In an interesting twist of events, DDR&E never put a priority on the inputs and requirements of the services. The aircraft industry was left to interpret which were the most important and to find a way to make them work together. Only one design was permitted, but it had to meet the conflicting inputs from the Air Force and Navy.

During this period, the Navy hoped to get a reprieve from the TFX based on world events. The naval blockade of Cuba against Russian ships loaded with armament

highlighted the possibility of a conflict between powerful naval forces. The Navy made one more failed attempt to sway McNamara before the aircraft selection process began. He denied the request.¹⁴ Another major event helped formulate the results of the coming selection process, the appointment of a new Secretary of the Navy, Fred Korth. A former assistant Secretary for the Army, Korth was warned from the beginning that the Navy opposed the process and McNamara made it clear that he wanted a joint program. Korth took over on 4 January 1962.

The first problems developed quickly within the Source Selection Board. The aircraft industry returned on 1 December 1961, with the proposals for review. The first review level did not have a single ranking Navy officer, largely due to the lack of naval participation in the SPO.¹⁵ Additionally, BuWeap normally handled this process with a review by the higher echelons of the Navy. In this process, the selection was based on proven design issues and formulated ability. The Navy was less focused on selecting a company that would deliver a design than on the actual design itself, letting the company selection happen later. The Air Force took the opposite approach, hoping to select the company and then work on perfecting the design with that selection. The process itself alienated the few Navy officers on the selection boards. BuWeap only had the ability to make recommendations to the Air Force Council, which was made up of eight Air Force generals. Only three admirals (two star) had voting rights on the Air Force Council and a unanimous decision was not required for selection.¹⁶

In the first selection process, the Navy officers on the boards were adamant that the proposals were not sufficient to meet the Navy's needs. The Air Force evaluation team agreed with this assessment, but the Source Selection Board (with only one naval

officer to the five Air Force officers) recommended approving the Boeing product.¹⁷ The Navy rejected this design based on the Boeing engine choice. The Navy objected to the MF-295 engine for two reasons. One, it was a paper engine. They had developed several engines and knew that the MF-295 would not be operationally ready for the aircraft on McNamara's timeline. Secondly, Pratt and Whitney had just developed the TF-30 engine for their F-4H and it was also the engine scheduled to be placed in the cancelled Missilier jet. The Navy felt comfortable with this engine design and did not want to gamble on another piece of unproven technology.

The General Dynamics TFX option had several deficiencies as well. The main issue was that it required a high wind-over-the-deck speed that would limit employment to only a handful of aircraft carriers, and even those may not be able to launch or recover under adverse conditions. This made it unacceptable. BuWeap sent a memo, requesting program cancellation once more.¹⁸ This memo was ignored.

The Air Force Council reversed the Source Selection Board's recommendation for the Boeing-only development. They agreed with the naval points and suggested that more time be given to both Boeing and General Dynamics to redevelop their proposals for resubmission. The chiefs and service secretaries agreed. McNamara agreed to give an additional 60 to 90 days for design. The two finalists were given the new requirements on 31 January and a new deadline.¹⁹

DDR&E became involved in the engine debate. The Air Force intended to let Boeing continue to work with the MF-295 engine, but the Defense Department overruled them.²⁰ The Air Force felt that it was an aircraft developed for their use and objected to a Navy developed engine that would be built in a Navy controlled plant. Resentment over

this decision was soon felt in the selection process as the Air Force pushed for an aircraft that would meet their needs, not that of the Navy.

Both agencies delivered their new proposals on 2 April. The Air Force Evaluation Board recommended the Boeing aircraft. The Source Selection Board recommended the same, stating that the General Dynamics aircraft had a center of gravity shift (one of the greatest barriers in variable swept-wing aircraft design) that would seriously affect its performance. The one person who objected to the Boeing decision was Rear Admiral Frederick Ashworth, the one Navy Officer on the board. It pushed forward to the Air Force Council. Here, all members agreed that the Boeing product was superior, but the Navy officers refused to support the selection of the aircraft.²¹

When Boeing moved to the new T-30 engine, their new design increased the weight by 4,000 pounds and also increased the wind-over-the-deck requirements beyond the Navy threshold. The General Dynamics version was also still heavy and did not meet the Navy's carrier requirements. The Navy would not accept either source until they had a design that worked for them. This was important for several reasons.

Since the Navy would only get one sixth of the total buy, their only time to influence design would be before source selection. After an aircraft was accepted, they would lose all ability to influence additional factors important to the Navy. The wind-over-the-deck issue could only be solved through one of two methods: reduce the weight or increase the area of the wing. Both of these were detrimental to the Air Force supersonic dash capabilities and led to a stalemate between the Air Force and Navy. Since McNamara was adamant that only one version of the plane could be developed, the services found themselves at odds over the smallest details.

BuWeap took this opportunity to try to break out of the process once more. Rear Admiral P.D. Stroop, head of BuWeap, sent another memo to the Chief of Naval Operations, Admiral George Anderson. In this memo, he stated that the chance of getting a bi-service aircraft that was acceptable to the Navy was remote. Moreover, he advised that further development was wasting money and time.²² Admiral Anderson then wrote a similar memo to Secretary of the Navy Fred Korth. He stated that he had little faith that the Navy needs would be met and that they should abandon efforts for a joint aircraft. He went so far as to draft a memo for Korth to sign saying that the program was a failure and that the Air Force should be allowed to develop the TFX alone.²³

Deputy Chief of Naval Operations, Vice Admiral Robert Pirie, found out about the memorandum and sent a copy to the Air Force.²⁴ He was worried that McNamara was serious and that if the Navy passed on this opportunity, they would not get a new fleet defense fighter. He additionally felt that the letter would not end the program, only delay it at the Navy's detriment. The Air Force officers agreed to Pirie's observations and also to the fact that a common aircraft would not ever be acceptable to both services.²⁵ Chief of Staff Curtis LeMay and Chief of Naval Operations Anderson approached their secretaries asking for divergence between the two designs. Secretary Korth never endorsed the Anderson's memo. Instead, he recommended to McNamara a divergence between the designs because this would be the only way to ensure a successful joint development.²⁶

McNamara had his office do a design study to verify the Navy's request. When they returned with a conclusion that weight could be saved without major structural differences, Secretary McNamara begrudgingly agreed to a third design run-off.²⁷

However, time was of the essence and he only authorized three weeks for the entire process. After authorizing a divergence of commonality on 9 June, Boeing and General Dynamics turned in their next design only six days later on 15 June.²⁸ The Evaluation Group had only five days to review the information before the Source Selection Board met on 20 June. The Source Selection Board only had one day to review the information.²⁹ This included a completely new wing design by Boeing and a total of six new Navy designs by General Dynamics. BuWeap had less than a day to review the information before making its recommendation to the Air Force Council. The Council took less than a day to make their unanimous recommendation: the Boeing TFX version should be selected as the source for design.³⁰ However, Admiral Anderson refused to state that the design was acceptable. Too little time had been given for the design research. Boeing's designs were only theoretical and the Navy had not had the time to verify through wind tunnel testing. Admiral Anderson recommended to Secretary Korth that Boeing should be selected, but that design studies should continue.³¹ The Air Force Generals agreed with the Navy position on the single source and additional design work.

The Evaluation Group, Source Selection Board, Air Force Council, Chief of Staff of the Air Force and Chief of Naval Operations all made the same recommendation to the Service Secretaries. However, Secretary Zuckert and Secretary Korth recommended that both Boeing and General Dynamics be given \$2.5 million for an additional 60 days to complete the design and another 45 days of evaluation by the various boards.³²

McNamara agreed and authorized the last round.

The last round's change of rules was especially of note to the Navy. Secretary McNamara authorized Colonel Charles Gayle to work with the two manufacturers on

their designs. He was the sole point of contact between the Evaluation Group and the two companies.³³ The impression given was that the Air Force was going to rig this competition to ensure that it would be the last run off. It was clear to the Navy that the Air Force favored the Boeing product and that they would need a serious reason to select the General Dynamics product over the one sought by the Air Force. Since the Navy was given no direct contact with the manufacturers, BuWeap funneled all of their requirements through the Air Force contact and hoped that their needs were given due priority.

On 11 September 1962, over a year after McNamara's initial instructions, Boeing and General Dynamics turned in their final designs.³⁴ Over the next 45 days, the designs were reviewed by every agency in the Navy and Air Force. They all made the same recommendation: the Boeing product was superior. Admiral Anderson and General LeMay made the same recommendation to the service secretaries. The Navy finally felt the design was sufficient and the Air Force was happy with the source. All parties finally agreed. On 8 November, the unanimous recommendation to select Boeing was sent up. On 21 November, unanimity was replaced with shock, as General Dynamics was officially awarded the contract.³⁵

The Navy picked the Boeing product for three documented reasons. One, it was what the Air Force wanted. There was not a justifiable reason to over-rule this mentality, especially since the Air Force would be buying the majority of the aircraft. Two, the Boeing product was the least common of the two choices. Boeing spent a great deal of time trying to design two different aircraft, one for the Air Force and one for the Navy. In the General Dynamics aircraft, 92 percent of the parts were identical (by structural

weight), but on the Boeing aircraft this was just 34 percent.³⁶ The Evaluation Group even called attention to this phenomenon by stating that the Boeing had created essentially two different airframes, one for the Navy and one for the Air Force. “It is estimated that 60 percent of the structural components of the wing, fuselage, and horizontal tail are different in the two versions.”³⁷ The last reason the Navy preferred the Boeing version was due to weight. Boeing relied heavily on titanium in development of the aircraft. Though this increased the cost of each airframe significantly, it also reduced the weight of those parts by more than two and half times. The smaller, individualized airframe that used innovative ways to stay light gave the Navy everything they were asking for in a fleet defense aircraft.

After the selection, the Navy had to simply wait to find out how the project was going to progress. Admiral Anderson retired on 1 August 1963, and Admiral David L. McDonald became his successor. During this period, Senator John McClellan held hearings on the TFX project. The Navy saw an opportunity to remove itself from the program and aligned themselves with Senator McClellan, a long-time Navy ally. The hearings were gathering support and it looked like the Navy might be removed from the program. But November brought a series of bad news.

The assassination of President John F. Kennedy ended the TFX hearings that featured Johnson and McNamara. Shortly afterwards, General Dynamics announced that the weight of the aircraft had increased from the contract specification of 38,804 pounds to an estimated 48,259 pounds empty weight.³⁸ The takeoff weight was now almost 16,000 pounds more than originally prescribed. The Navy was not completely fault-free in this circumstance. Normally, military specifications are applied with a little bit of

freedom and flexibility. These rules and specifications had built up over the previous 50 years and sometimes were at complete odds with one another, creating contradictory requirements and equipment. The Navy showed no remorse in enforcement of these rules, undoubtedly adding several thousand pounds to the aircraft they wanted to be light.³⁹

In January 1964, BuWeap recommended a complete review of the entire project by the new Secretary of Navy, Paul Nitze . They felt that the weight gains were unacceptable for any aircraft in the Navy and that the performance of the aircraft would never be acceptable at the current weight.⁴⁰ George Spangenberg, the author of the original report, later admitted that this study was an attempt to force a second design for the Navy version, essentially creating a completely different aircraft for the Navy.⁴¹ The service secretaries reacted to this report with two solutions. One, a Super Weight Improvement Program (SWIP) would be instituted to focus contractor efforts on weight management. Second, a fall-back redesign would be prepared for the F-111B.⁴²

The SWIP program began immediately and the contractors began to try to find ways to remove weight from the Navy version, sometimes removing just a few ounces from each individual piece. As focused as the Navy was on saving weight, it was uncompromising in several high-weight factors excluded by SWIP. It refused to remove the internal escape capsule in favor of the more modern ejection seat. They would not reduce the loiter time or G force requirements for the aircraft, requiring more fuel and stronger parts. The final problem was the Phoenix missile. Weighing over 1,000 pounds apiece, the requirement for the F-111B was to carry six of these internally. This increased the weight significantly. When facing the same problem ten years later with the Navy-only F-14 development, the Navy bent their needs and substituted Sparrow missiles,

which weighed 300 pounds each.⁴³ The Navy constantly complained about weight, but rarely made any adjustments through SWIP to help with the weight. In July 1964, they directed an additional 2,850 pounds of weight gains to make the aircraft compatible with carrier operations. The problem was that 20,000 pounds of the aircraft was designed by second and third party contractors according to government standards for the avionics, engines and other components.⁴⁴ None of this weight could be affected by the SWIP.

Further weight reductions would require a unique redesign for the aircraft, precisely what the Navy wanted. In mid 1963, the Navy produced a vertical attack aircraft requirement that fell outside of the confines of the fleet fighter defense aircraft requirement. When the proposal was finally designed by Boeing, its aircraft was so close in design to the original Boeing TFX F-111 design that they jokingly called it the F-55.5.⁴⁵ DDR&E put a halt to the program and questioned the Navy's intent with a supersonic aircraft used for ground attack. McNamara backed the decision and postponed the aircraft development until after the F-111 was fully developed. The aircraft was later produced and became the A-7.⁴⁶

After the Navy lost the vertical attack aircraft replacement, the order for the F-111B increased to 705 units in March 1964. However, only a few months later BuWeap convinced the Navy to reduce this order number to 335 units after the failed experiments with weight control under SWIP.⁴⁷ BuWeap would continue to request and be granted a smaller and smaller buy, resulting in only 50 aircraft slated for Navy purchase two years later. BuWeap also identified another problem with the weight of the aircraft, the arresting gear of the carriers themselves. With the new base weight of 43 to 46,000 pounds, and a landing speed of 130 knots, the aircraft carriers' arresting gear would be at

its maximum ability. The Navy requested General Dynamics to reduce the landing speed of the aircraft by fifteen knots.⁴⁸

The civilian leadership started to see the joint aspect of this acquisition slipping away in 1965. Secretary of the Air Force Zuckert contacted Secretary Nitze to discuss the problems with the program. Zuckert was convinced that high-lift flap devices would improve the landing and takeoff characteristics for the Navy.⁴⁹ However, Navy buy-in to the program seemed to waning. Nitze agreed and directed a new resurgence of Navy participation within the SPO. The number of Navy officers attached to the SPO increased significantly, and the SPO deputy director became Rear Admiral W.E. Sweeney.⁵⁰ BuWeap violently opposed this, as it took much of the power away from their central office at Langley.

In May 1965, the first jets were delivered to the Navy for flight testing. They already had some of the reports from the Air Force test pilots and knew the factors that they were reporting. The Navy had four months to review the aircraft before the formal review began in October. None of the testing went well. None of the jets delivered had any of the SWIP weight savings applied and all of the aircraft still had the original TF-30 engine. However, this is not where the problems originated for the naval flight tests.

Since the Navy was responsible for its own testing and had largely felt forced into the project, now was the opportunity to show how inappropriate it was for their use. This was first shown by the types of pilots chosen for the testing. The TFX F-111B was developed with a stand-off mission in mind, using advanced missiles and avionics in order to defeat the enemy. The Navy pilots were used to “dog fighting” and the aircraft performance was not able to do this as well as other aircraft, specifically the F-4D.⁵¹

Engineers had designed the systems to do the fighting, whereas the pilots wanted aircraft performance primary to the systems.⁵² These pilots had a doctrinal prejudice against the type of aircraft the F-111 represented.

The next problem came from the engineering change with the aircraft's Turbo-fan engines employed. Pratt-Whitney developed the new engines to be more efficient than their previous turbo-jet engines. The difference was that the new engine had an afterburner capability. When activated at full afterburner, it was much faster than the turbo-jet engine, which did not have that feature. This was a problem, however, in that the standards required the tests to be accomplished at military power (not afterburner) and the turbo-fan had much lower performance at this standard. Afterburners were new and not incorporated into the testing manuals.⁵³ The pilots returned and reported that the F-111 had limited power performance. One report stated that, "power performance of the vehicle is totally unsatisfactory from mission accomplishment and safety of flight aspects."⁵⁴ The engine compatibility with the fuselage also prevented any afterburner testing, so the pilots never even saw what the aircraft could do in afterburner mode.

The final reported problem was the crux of the Navy's issue: the carrier compatibility. The aircraft could not pass the single-engine rate-of-climb test. This was test of whether an aircraft that was attempting to accomplish a carrier landing on only one engine and no afterburners could complete a go-around without having to eject when given a wave-off.⁵⁵ The F-111B could not complete the test due to the responsiveness of the turbo-fan engines and the afterburner restriction. Pilots, both Air Force and Navy, reported a directional stability issue with the aircraft that was more important to pilots landing on a moving aircraft carrier.⁵⁶ Finally, the actual aircraft failed to meet the wind-

over-the-deck requirements put into the contract. It did not matter that it was actually superior to the F-4D; the TFX was the aircraft being evaluated.⁵⁷

The Navy leadership had to take the reports seriously. There was inherent bias in the program from several different sources, but the TFX did fail to meet several of its programmed requirements. The Secretary of the Navy had no way to distinguish negative views of the program from actual problems with the aircraft for naval use at sea. For those who had been looking for reasons to end the program, the deficiencies offered the perfect excuse to abandon the project.

The resulting Navy requests and requirements for the TFX starting in 1966 led directly to the eventual cancellation of the project. First, the Navy requested more power in the engines. Pratt-Whitney provided larger, more powerful engines.⁵⁸ The larger engines resulted in more weight on the aircraft. The Navy then requested that the landing speed be reduced by fifteen knots to accommodate the heavier weight. This seemed like the end of the project at the time, as no technical solution existed. However, a few months later, General Dynamics resolved the landing speed issue. They added a unique second slat to the leading edge of the wing, increasing the area and deflection of the wing flaps.⁵⁹ The additional lift decreased the landing speed by the requisite fifteen knots through a technological advance in aviation.

Now that the landing speed was solved, a new Navy problem surfaced. The Navy complained that the directional control was difficult at that speed. Additionally, they noted that at the slow landing speed, the engines were running at idle.⁶⁰ If something happened, the pilot would need to increase power and the reaction time of the engine was worst when coming from idle. General Dynamics fired back that this was an engine

problem, and they had no control over the engine design or efficiencies since Pratt-Whitney sold the engines directly to the Navy. The Navy recommended General Dynamics add more artificial drag to the aircraft, which would kill all supersonic capabilities of the airframe.⁶¹

General Dynamics approached the Navy in December 1966 to discuss what would be necessary to make the TFX F-111B an acceptable aircraft. The Navy, through BuWeap, agreed to deliver their needs through a list of desired changes.⁶² The list was consolidated into a package of modifications labeled the “N1” package. The N1 modifications included: raised pilot's seats, a two foot extension of the nose, an eight-inch rearward shift of the landing gear, a forward redistribution of the avionics, a sharper angle windshield, a higher wing-flap deflection angle, and a more powerful version of the TF-30 engine.⁶³ In all, the total fixes added an extra 2,500 pounds to the aircraft, in addition to the request for another 2,000 pounds of fuel capacity.⁶⁴ The extra fuel ended up helping the aircraft meet its specified loiter time, but was crippling politically. The main problem with the aircraft was always weight, and the Navy added more and more weight requirements, all the while complaining about it. None of the changes prescribed would be available until late 1967, but flight testing would continue until that time.⁶⁵

The flight tests in early 1967 did not help. The first two SWIP birds were finally in the hands of the test pilots, but it did nothing to change their minds about earlier test results. The flight tests conducted in March and April were very negative. In one of the pilot reports, the conclusion was harsh, “The F-111B remains unfit for service use as previously reported and was found to be incapable of carrier-based operations.”⁶⁶ Before this report could be evaluated, disaster struck the F-111B. One of the two SWIP aircraft

crashed in late April 1967. The formal evaluation of the aircraft was delayed eight months to February, 1968 in order to review the accident and receive another SWIP bird from General Dynamics. However, delivery of this aircraft itself was delayed when Pratt-Whitney postponed the P-12 version of the TF-30 engine until the spring of 1968.⁶⁷ The Navy never completed the carrier compatibility tests and another aircraft would not be available for testing for almost a year.

In late 1966, Senator McClellan had reinitiated his investigation of the TFX program and the F-111B in particular. He successfully blocked the funds for the lead-production items for the F-111B in the Senate. After the crash in 1967, he was able to do it again for the next fiscal year.⁶⁸ He did not yet have the political capital to cancel the program outright, but the environment was quickly changing.

At the July 1967 Moscow Air Show, the USSR revealed six new next-generation fighter aircraft. Each was more capable than the F-4D and the Navy became nervous that the Soviets had outpaced the United States in fighter technology.⁶⁹ The F-4 was now obsolete and the Navy was aware that the F-111B did not provide an acceptable alternative. They wanted a fighter aircraft that would take them into the 1980s, and the F-111B was not that aircraft. The new Chief of Naval Operations, Thomas Moorer, initiated a fighter study with Grumman to evaluate the F-111B against other Soviet fighters of the era. This was the same month that the Navy got a new Secretary, Paul Ignatius. Ignatius was an outspoken opponent to the TFX program and quickly found allies in the CNO and BuWeap. Grumman returned its report in late October, stating that the F-111B would not meet the Navy's needs for an air superiority fighter capable of defeating Soviet jets in close engagements.⁷⁰

In November 1967, the Chief of Naval Operations received a series of unsolicited aircraft designs from Grumman. Within a few weeks, he also received unsolicited new designs from several other companies to include Ling-Temco-Vought, North American Rockwell and even General Dynamics. As a result of the delayed aircraft, Admiral Moorer delayed the carrier testing for the F-111B, advocated a new need for a vertical fighter attack aircraft and made one last move to cancel the Navy's involvement with the TFX. The only way to get the fighter the Navy wanted was to start completely over, taking in the lessons from the TFX experience and developing an aircraft that was made specifically for the Navy. Admiral Moorer contacted Secretary Ignatius and Senator McClellan to craft an exit strategy for the Navy.

They did not have to look far. The budgetary meetings for the Fiscal Year 1969 hearings were in the final stages and if the Navy were to move forward with the program, it would take a major financial commitment. The total money needed to continue the Navy program was \$585 million.⁷¹ Senator McClellan offered the political support necessary to help kill the budget for the TFX Navy version. Also, Former Secretary of the Navy Paul Nitze had moved over to be the new Assistant Secretary of Defense. He had become more critical of the TFX over the years and now was in a position to advocate its demise from within the Office of the Secretary of Defense. When Robert McNamara announced late in November that he would resign from his post as Secretary of Defense in February 1968, the Navy had the last piece of the puzzle fall into place.⁷²

The timing was critical to not only end the TFX, but eliminate the possibility of future joint operations. The Air Force was already seeking military approval to develop a new fighter aircraft. Many congressmen were calling for a second joint operation to take

place. Admiral Moorer quickly tied his requirements for a future fighter to the Phoenix missile system (which would be dropped later as a requirement). All of this would be discussed at the budget hearings, scheduled to begin in February 1968.⁷³

Secretary of Defense Robert McNamara resigned on 28 February, 1968. The very next day, the Navy through Secretary Ignatius and Admiral Moorer presented their results of the TFX flight tests and recommendations to Congress. They recommended cutting the buy from 30 down to eight. They presented the results of the fighter study comparing fighter aircraft to those showcased at the 1967 Domodedovo Air Show. The Navy study recommended concentrating new budgetary funds on developing a new vertical fighter aircraft specifically designed for the Navy. After the designs were concluded, they would make a recommendation as to which aircraft better suited the needs of the Navy. The Senate Armed Services Committee voted on 28 March 1968 to cancel the F-111B and Navy TFX program.⁷⁴

Although this decision was to be kept a secret for several months until after the next election, reports of the cancellation soon leaked into the media. There were no serious repercussions for the Navy commanders or the civilian leadership.⁷⁵ It took an overt move, political strength and the departure of McNamara for the program to be cancelled. The biggest concern for the Navy was a trend. Ironically, the new Navy-developed vertical fighter aircraft, the F-14 Tomcat, failed to meet more design requirements than the F-111B. Because it was internally controlled, however, the deficiencies were somehow more acceptable.⁷⁶

The Navy blamed the Air Force for many of the problems with the aircraft. The Air Force blamed the Navy for their long lists of requirements. In actuality, neither of

these agencies were solely responsible for the program's problems. They both needed to understand the needs of the civilian leadership to understand the forces behind the TFX.

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²Ernest J. King, USN, –Major Combatant Ships Added to United States Fleet, 7 December 1941 - 1 October 1945,” *Ibiblio*, US Navy at War 1941-1945: Official Report to the Secretary of the Navy, <http://www.ibiblio.org/hyperwar/USN/USN-King/index.html> (accessed 8 January 2011).

³Jon Lake, *McDonnell F-4 Phantom: Spirit in the Skies* (London: Aerospace Publishing, 1992), 233.

⁴Robert F. Coulam, *Illusions of Choice: The F-111 and the Problems of Weapons Acquisition Reform* (Princeton, NJ: Princeton University Press, 1977), 312.

⁵*Ibid.*, 43.

⁶*Ibid.*, 57.

⁷U.S. Senate, *TFX Hearings—First Series*, Testimony of the Assistant Secretary of the Navy for Research and Development, Dr. James H. Wakelin, 6:1533-1534.

⁸Coulam, 43.

⁹Robert J. Art, *The TFX Decision: McNamara and the Military* (Boston, MA: Little, Brown and Company, 1968), 40.

¹⁰*Ibid.*, 44.

¹¹U.S. Senate, *TFX Hearings—First Series*, Prepared statement by Secretary of the Air Force Eugene Zuckert, 8:1899.

¹²U.S. Senate, *TFX Hearings—First Series*, Memorandum on TFX for the Secretary of the Air Force and the Secretary of the Navy, 1 September 1961, 6:1514

¹³*Ibid.*, 1515.

¹⁴John F. Kennedy Presidential Library and Museum, —Cuban Missile Crisis,” <http://www.jfklibrary.org/JFK/JFK-in-History/Cuban-Missile-Crisis.aspx> (accessed 12 February 2011).

¹⁵U.S. Senate, *TFX Hearings—First Series*, 1:43.

¹⁶*Ibid.*, 43.

¹⁷Art, 65.

¹⁸*Ibid.*, 67.

¹⁹U.S. Senate, *TFX Hearings—First Series*, Written statement by Secretary McNamara, 2:381.

²⁰*Ibid.*, 378.

²¹U.S. Senate, *TFX Hearings—First Series*, Testimony of Robert Emmett Dunne, assistant counsel for the McClellan Subcommittee, 1:59.

²²U.S. Senate, *TFX Hearings—First Series*, Testimony of Admiral Ashworth, 1:58.

²³U.S. Senate, *TFX Hearings—First Series*, Written statement by Secretary McNamara, 2:379.

²⁴U.S. Senate, *TFX Hearings—First Series*, Memorandum for Record on the TFX, A.W. Blackburn, 1 March 1963, 5:1204.

²⁵Art, 71.

²⁶U.S. Senate, *TFX Hearings—First Series*, Memorandum from the Secretary of the Air Force and Secretary of the Navy to the Secretary of Defense on the TFX Program, 1 June 1962, 2:513.

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²⁸*Ibid.*, 73.

²⁹U.S. Senate, *TFX Hearings—First Series*, Prepared statement of Admiral Ashworth, 2:498.

³⁰Art, 73.

³¹U.S. Senate, *TFX Hearings—First Series*, Written statement by Secretary McNamara, 2:380.

³²U.S. Senate, *TFX Hearings—First Series*, Prepared statement of Secretary of the Navy Korth, 6:1399.

³³U.S. Senate, *TFX Hearings—First Series*, Memorandum to the Chairman of the Source Selection Board from Secretary of the Air Force Zuckert on the TFX Program, 29 June 1962, 1:65.

³⁴Art, 77.

- ³⁵*Ibid.*, 83.
- ³⁶U.S. Senate, *TFX Hearings—First Series*, 1:270.
- ³⁷U.S. Senate, *TFX Hearings—First Series*, Fourth Evaluation Report of the TFX Program Officer, 3:691.
- ³⁸Coulam, 269.
- ³⁹*Ibid.*, 270.
- ⁴⁰U.S. Senate, *TFX Hearings—Second Series*, Letter to the Chief of Naval Operations, from the Chief of the Bureau of Naval Weapons, 5 February 1964, re F-111B Status, 2:401.
- ⁴¹U.S. Senate, *TFX Hearings—Second Series*, 2:408.
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- ⁴³Coulam, 271.
- ⁴⁴*Ibid.* 273.
- ⁴⁵Richard G. Head, *Decision Making on the A-7 Attack Aircraft Program* (Syracuse University, NY: Syracuse Press, 1970) 125-134.
- ⁴⁶*Ibid.* 133.
- ⁴⁷U.S. Senate, *TFX Hearings—Second Series*, 3:462.
- ⁴⁸U.S. Senate, *TFX Hearings—Second Series*, 2:456.
- ⁴⁹U.S. Senate, *TFX Hearings—Second Series*, Memorandum for the Secretary of Defense, from Secretary of the Air Force Eugene Zuckert, 13 April 1965, re F-111 Program, 2.
- ⁵⁰*Ibid.*, 7.
- ⁵¹Leonard Sullivan Jr., *Report of PHOENIX/F-11B adhoc group*, Memorandum for Director of Defense Research and Engineering, 1 October 1964, 1.
- ⁵²U.S. Senate, *TFX Hearings—Second Series*, 3:483.
- ⁵³Captain John Francis, Jr., —F11: A Pilot's View,” *Air Force Magazine* 54 (April 1971): 56.

⁵⁴*Phase I Navy Preliminary Evaluation of the Model F-111B Airplane: First Interim Report*, Navy speed letter report for the Chief of the Bureau of Naval Weapons, 3 November 1965, 2.

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⁵⁸Erwin J. Bulban, “General Dynamics Defends F-111 Program,” *Aviation Week and Space Technology* 87 (9 December 1957): 34-37.

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⁶¹Donald C. Winston, “Navy Studies F-111B Offensive Missions,” *Aviation Week and Space Technology* 87 (23 October 1967): 29.

⁶²U.S. Senate, *TFX Hearings—Second Series*, 3:559.

⁶³U.S. Senate, *TFX Hearings—Second Series*, 1:109.

⁶⁴*Ibid.*, 110.

⁶⁵Armed Forces Management, “An AFM Essay: The F-111B - White Hope or White Elephant?” 13 (July 1967): 28-29.

⁶⁶U.S. Senate, *TFX Hearings—Second Series*, 3:512.

⁶⁷U.S. Senate, *TFX Hearings—Second Series*, 1:68.

⁶⁸George C. Wilson, “McClellan to Resume F-111 Investigation,” *Aviation Week and Space Technology* 85 (22 August 1966): 17.

⁶⁹Congressional Quarterly Weekly Report, “Navy Facing Dilemma Over Decision on Fighter Plane,” 26 (16 February 1968): 286.

⁷⁰*Aviation Week and Space Technology*, “Navy Investigates F-111B Substitutes,” 88 (29 January 1968): 28.

⁷¹U.S. Senate, Committee on Appropriations, Department of Defense Appropriations for Fiscal Year 1969, 1398.

⁷²Coulam, 303.

⁷³*Ibid.*, 304.

⁷⁴U.S. Senate, Committee on Armed Services, Authorizing Appropriations for Military Procurement, Research and Development, Fiscal Year 1969, and Reserve Strength, Report No. 1087, 90th Cong., 2d Sess., 10 April 1968, 3.

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CHAPTER 4

THE CIVILIAN INFLUENCE

The common perception surrounding TFX development and the joint development issues within the services focused on parochial issues or a clash between the services and the Secretary of Defense. Though these factors are undeniable, there were a large number of civilian forces at work that contributed to the failings of the TFX as a successful joint program. This chapter emphasizes the civilian leadership perspectives, motivations, and history. The TFX manufacturing source companies are included in this analysis.

In the years following World War II and Korea, there was a lot of worry among the civilians leading the military and in Congress. The Nuclear Age had unquestionably changed the rules of warfare, but Korea indicated that limited wars were also possible in the future. A restricted war budget guaranteed that each service fought hard for intrinsic (organic) capabilities to ensure that they received the largest possible piece of the budgetary pie. The Air Force was the most successful service, as it retained the nuclear mission and later gained sole control of this mission during the Eisenhower administration.¹

The New Look was the financial piece of the Massive Retaliation policy, first introduced by Secretary of State John Foster Dulles in 1954. The New Look hoped to limit military spending by focusing on the nuclear mission and deterrence.² With the launch of Sputnik and a key set of Russian missiles, the United States entered into the missile race. The New Look policy failed to prevent the defeat of France by the Viet

Minh at the Battle of Dien Bien Phu.³ So the policy shifted even further to that of mutual deterrence and nuclear sufficiency.

Each of the services scrambled to develop missile technology. The Army, Navy and Air Force all started their own programs under their own agendas. There was legitimate fear that nuclear weapons would supplant their traditional missions. During this time, there was a high turnover within the Secretary of Defense, and none of the secretaries sought to channel the actions of the services into a congruent national security entity. Congress took notice of this lack of focus and Charles H. Donnelly, commented in 1957 to the House Appropriations Committee, “Each service it would seem, is striving to acquire an arsenal of weapons complete in itself to carry out any and all possible missions. It is the firm belief of this committee that this matter of rivalry is getting completely out of control.”⁴ The House of Representatives began to worry if this duplication of effort was actually slowing down the modernization effort for all services.⁵

Meanwhile, the Air Force was already developing its century series aircraft and a policy took effect that would affect TFX development. The “Cook-Craigie” plan hoped to speed up the production of aircraft in order to get the final project out to the field as fast as possible.⁶ Under its rules, milestones within development were setup to obtain a large amount of concurrency. The true purpose was to reduce the lead-time between the initiation of a program and the operational capability, but the Cook-Craigie plan came with a list of requirements. One requirement increased the number of research and development prototypes. A second required that the prototypes would be built using a finalized version of tooling, versus individualized tooling that was not set into the machinery. A third accelerated testing based on a large number of prototypes. And lastly,

production would commence while the aircraft were still in testing.⁷ The nature of this program assumed that any problems discovered during testing would be minimal and therefore easy to fix within the production line. This type of development might seem incredible today, but technology was developing rapidly. The services were under a great deal of pressure to get their aircraft concepts from the drawing table to the field as quickly as possible. Additionally, further funding for a new program was unlikely if an aircraft was still on the production line. Only fielded aircraft could be obsolete. By 1958, this type of production was commonplace within the military aircraft industry.

One year earlier, Secretary of Defense Charles Wilson cemented the need for nuclear weapons in the military psyche when he stated, “The smaller atomic weapons, the tactical weapons, in a sense have now become the conventional weapons.”⁸ For the previous decade, almost all funding had gone to nuclear programs. The Truman Doctrine, NSC 68, Massive Retaliation, the New Look, and the New, New Look all centered the military's funding and mission focus on nuclear capability. Medium range ballistic missiles were moved into Europe and other strategic locations around the globe. The United States was prepared for a nuclear war, despite the kind of war that might occur. Eisenhower was focused on ensuring he would not lose a nuclear war with the Soviet Union, everything else was negotiable.

A significant change happened within the Department of Defense in 1958 with the creation of the Director of Defense Research and Engineering (DDR&E). The position for a manager of research for military engineering called the Research and Development Board had been put into place under the National Security Act of 1947.⁹ In 1949, the position was broken out into two advisors who became assistants to the Secretary of

Defense. On 8 August 1958, the position was restored to an individual who managed a staff. The DDR&E would report to the Secretary of Defense on acquisitions and research for all of the military services.¹⁰ Once regaining autonomy, DDR&E started to try and find ways to save money and stop duplication of the military spending.

The new staff of DDR&E contained engineers and scientists that understood the military system. The vast majority of these personnel were retired Air Force officers and engineers.¹¹ DDR&E focused on collecting the specialists who built the missile systems only a couple of years earlier, hoping that their knowledge would help with the streamlining of service requirements. A disproportionate amount of former Air Force personnel ensured that DDR&E would understand the Air Force issues better and favor Air Force style solutions.

In Eisenhower's last year, he halted a large number of military projects. Most of these cancellations were due to the influence of DDR&E through his final Secretary of Defense, Thomas Gates.¹² Eisenhower asked DDR&E to begin efforts to coordinate requirements between the services, in essence, to begin joint military acquisitions. DDR&E opened the Weapon System Evaluation Group and began to determine where they could consolidate military systems.¹³ This Weapon System Evaluation Group coordinated with NASA to assess the needs of the new Air Force fighter and made recommendations for consolidation with the Navy in 1960. Eisenhower realized he would never have the political will or time to force a joint project, so he simply put all new acquisitions on hold for the next administration.¹⁴

President John F. Kennedy's campaign stressed reform and change to the doctrine and management of the Department of Defense. Personally upset about the number of

duplicated projects, he intended to end the high number of identical projects from the 1950s between the four services. Additionally, he sought to reintegrate something he felt was missing from the US military structure: a conventional capability.¹⁵

Kennedy hired the man he felt best embodied these ideals: Robert S. McNamara. McNamara was a beltway outsider. Before the war, he earned a Harvard MBA and Harvard Business School hired him to teach business just a couple years later. McNamara served as an Air Force lieutenant colonel during World War II, where he worked in the Office of Statistical Control.¹⁶ His job was to look at the efficiencies and effectiveness of the bomber campaign, under the control of Major General Curtis LeMay. In 1946, he went to work for the floundering Ford Motor Company. He helped modernize their operations through planning, organization and a unique set of management control systems. He started out in the financial analysis section, but within fourteen years, he had advanced to the very top position in the company. At 43, Robert McNamara was the first president of the Ford Motor Company not related by blood to Henry Ford. He was president for six weeks when Kennedy asked him to take the post of Secretary of Defense.¹⁷ He accepted in January 1961.

Upon reporting to the new Office of the Secretary of Defense, McNamara shared the Eisenhower administration's National Security Council assessment with President Kennedy. It stated that the current defense policy was to rely on nuclear retaliation for any size aggression by a foreign nation.¹⁸ McNamara and Kennedy immediately started working on a revision to this DoD policy. They wanted to modify the heavy reliance on nuclear weapons to give the US a wider variety of defense capabilities. McNamara was adamant that the US needed a conventional capability built into its air defenses.¹⁹ The

two quickly devised a new military policy known as Flexible Response. Kennedy gave McNamara a mandate to fix the DoD. He wanted a military that was less wasteful, more cost effective and focused on the conventional fight.²⁰ This fit perfectly with McNamara's personality and individual skill set.

McNamara wanted to approach military acquisition from an economic standpoint. He would impart efficiencies into the system through economic policies he learned at Ford. Instead of drawing up plans based on a military requirement, he insisted that the cost of the program itself be a key factor in the decision about the types of equipment the military would develop. If the cost were a factor in consideration before looking at requirements, then the military requirement would drive the budget, not the other way around. Finding ways to reduce needs, maximize efficiencies, and eliminate spending for the sake of spending, were the cornerstones of McNamara's vision for the Department of Defense.²¹ Using this cost-effectiveness technique, he could balance the military effectiveness of a project against the cost. If not balanced, the project would not be built.

DDR&E chief Herbert York approached Secretary McNamara about the Air Force and Navy requirements for their new fighters. York recommended to McNamara that these might be met by one aircraft and this would a good place to begin joint acquisition. McNamara looked at the problem analytically. The Air Force TFX aircraft was being sold as a marvel of engineering that would fill multiple missions.²² McNamara wanted options up to and including full nuclear war, and the TFX promised those flexibilities. Its large internal load would allow for conventional or nuclear weapons to be carried to any remote location on the planet due to its transatlantic capability. Its promise of avionics and fighting capability would allow it to be used as an air superiority vehicle

if aircraft needed to reach somewhere fast. Its dash capability would allow for reconnaissance and intelligence gathering without detection. It was touted as a bomber, fighter, transatlantic reconnaissance aircraft that could fill both the nuclear and traditional roles.²³ He was persuaded that technology could overcome all previous hurdles to aviation. The multi-mission aspect of the aircraft appealed to McNamara and he wanted to know if it could be used to fill the requirements requested by all the other services.

After being in office for less than a week, McNamara initiated a Limited War Panel to look at the TFX and other cost saving possibilities. The panel focused on the recommendations for a multi-service fighter-bomber that would help the US conduct limited war operations. Assistant Secretary of Defense on Internal Security Affairs, Paul H. Nitze, headed the panel. He would later become the Secretary of the Navy in 1963.²⁴ The panel recommended that all four services use the multi-mission Air Force TFX to fit their fighter/tactical aircraft needs.²⁵

The panel gave McNamara what he really wanted. He would not need to buy four different aircraft for four different services. TFX would require only one development program, one set of tests, and one training program. It would also give him great economy of scale on the cost per copy along with a single source for replacements and maintenance. It was this type of mentality that helped him turn around Ford Motor Company, and he hoped to do the same thing with the Department of Defense. On February 14, 1961, only 24 days after becoming the Secretary of Defense, McNamara charged York and the DDR&E to study a joint tactical experimental fighter (TFX) for all four services based on the Air Force design.²⁶ The services were to explore the option and

coordinate their specific operational requirement development plan through the DDR&E. The first joint aircraft development had started.

York held the Committee on Tactical Air from March to May. During this period, the committee addressed two separate issues. Could the TFX support the Navy's need for the Missileer aircraft request? Additionally, could the TFX supply the close air support needs for the Navy, Marines and Army?²⁷ Assistant Secretary of the Navy for Research and Development, Dr. James Wakelin, contested the possibility of either of these options and quickly became the spokesman for all of the services except the Air Force. He was soon asked to become a member.²⁸ The committee listened to his opinions, but also analyzed the tactical air requirements for the military from 1962-1971. The committee quickly came to the realization that one aircraft could never fulfill all the needs of all the services to satisfaction of every military branch.²⁹

The Committee offered its final decision on 19 May, 1961 as part of ~~Project~~ "Project 34." They could not reconcile the needs for a simple, slow and small close air support vehicle wanted by the Army and Marines from the complicated, fast, and large aircraft that the TFX represented.³⁰ The results of the study forced McNamara to accept two separate aircraft to fulfill the tactical air needs of the services. The first was to be called the VAX (attack aircraft, experimental) and the other TFX (tactical fighter, experimental). The Navy would administer and source the VAX, while the Air Force would administer the TFX. However, the Navy was not able to convince the committee to separate the Air Force and Navy in the second program.³¹ McNamara now had to exert his will to ensure his idea of a joint aircraft would become a reality.

Once this information was released, McNamara was flooded with a number of players who wished to influence the outcome of the TFX program. DDR&E continued to offer advice to McNamara, which he accepted freely and without question to motives. He had already been warned that the services were filled with parochial interests and they would oppose any joint program. The Air Force and Navy did nothing to counter this accusation. However, DDR&E was filled mostly with Massive Retaliation specialists hired by the Eisenhower administration. These government workers were hired under the older constructs of the Office of the Secretary of Defense, many of whom helped develop the concepts and practicalities of Massive Retaliation as the National Security Strategy. The TFX represented the older ideals of nuclear warfare as desired by the Air Force with a limited capability for conventional warfare. DDR&E continued to push the multi-mission aspect of the aircraft, but all of these multiple missions were designed to help enhance the nuclear capability.

Just as important as the people advising McNamara during this stage was the lack of people who should have been. Alain Enthoven, Deputy Comptroller of the Office of Secretary of Defense, should have been giving inputs to the new administration on future projects based on technological advances.³² However, Enthoven and his office were not only a brand new creation; they were subordinate to DDR&E. His analysts started to find real flaws with the development of the TFX and its reliance on certain technological advances. The biggest concern was their perception of concurrent development and testing while the production line was running.³³ Also, they foresaw many of the conflicts between the Air Force and Navy over size and use of the aircraft. To disclose all of this information from within the Office of the Secretary of Defense when McNamara had

already made his decision would be detrimental to the program and the relationship with DDR&E. Enthoven directed his staff to go along with whatever DDR&E concluded to avoid the controversial subject.³⁴

Also during this period, NASA directed its objections and questions to the Air Force, rather than DDR&E or the Secretary of Defense. They raised serious questions about the supersonic capabilities and their effect on the aircraft's design. Though the information was shared with the aircraft industry, none of these concerns reached the Committee on Tactical Air or the Limited War Panel.³⁵ Also, McNamara did not hire or seek out any system analysts for independent thought on the TFX project. This oversight would not become obvious to him for another five years, during the Icarus meetings.³⁶

On 7 June 1961, McNamara made his decision. The reaction of the services was exactly what he had been warned about. Both responded with highly parochial arguments against a joint development. Neither service made the argument in terms of service autonomy or retaining their service identity through separate capabilities. They chose instead to argue on a track of technological infeasibility based largely aerodynamics and technical problems.³⁷ Though these were true issues to the services, it left McNamara blind to the real problem both services felt with respect to the TFX. The constant arguing and fighting led McNamara to ask Air Force Secretary Zuckert to work with Secretary of the Navy Connally to find consensus. Zuckert and Connally were both new to the posts and had little military experience. Neither understood the parochial debates from their respective services.³⁸ Despite their best efforts, on 22 August, Zuckert reported to his boss that they could not come to an agreement between the Air Force and Navy over requirements.

Secretary Zuckert realized that the Air Force was focused on an offensive supersonic mission, while the Navy version was still wrapped around the needs of the Missileer program in a subsonic, avionics focused attack platform.³⁹ Secretary Connally went into more detail, saying that the compromised TFX would cripple the Navy. It would produce only 37 percent effectiveness, would have only a limited number per aircraft carrier, increase the safety hazards on carrier decks, raise the cost of procurement and cause serious issues with the reliability of the radar.⁴⁰ McNamara initially took these inputs and passed them along to Harold Brown, the new director of DDR&E. His direction was to work from the SOR 183 and look into the feasibility of meeting the Navy's needs.⁴¹

On 1 September 1961, the Soviet Union stepped in and helped McNamara with his decision. In the early hours of the day, the Soviet Union resumed atmospheric nuclear testing, breaking a tenuous test ban that had been in place for over three years. The French government had tested their first nuclear bomb in the Sahara Desert the year before and three party talks on nuclear testing between Great Britain, the US and Soviet Union had broken down only a few months earlier.⁴² McNamara was upset that his plans for developing the TFX were held up in bureaucratic red tape while the Soviets tested nuclear bombs. He decided to do something about the stalemate and make the kind of decision he was used to making at Ford; he dictated what the services would get.⁴³

The 1 September memorandum that resulted was only the beginning of McNamara's plan to crush opposition to the program. He needed to ensure that both the Air Force and Navy were without alternatives. First, he cancelled the F-105. Although the aircraft was still in production, he cancelled the remaining order. He was unhappy with

the overall conventional capabilities of the aircraft and it would free up funds for another aircraft he felt had more limited war potential: the Navy's F-4D Phantom II. He directed that the Air Force purchase the F-4 to fill the gap of their fighter aircraft needs. The F-4 was superior to the F-105 in almost all categories that mattered to McNamara. Secondly, he officially cancelled the Missileer program. Up to this point it had been on permanent delay. Cancelling this program would ensure the Navy would have to work with the Air Force to develop a fleet defense aircraft. McNamara was heavy handed in his selection of the TFX requirements, and largely made most of the decisions himself based on information he had been given. Despite all the compromises he enforced, he never eliminated one thing from the TFX aircraft - its inherent focus on nuclear delivery.

The 1 September memorandum dictated that DDR&E would control the program. Under Harold Brown's direction, Dr. Marvin Stern and A.W. Blackburn wrote the guidelines for the joint development after working with Air Force Chief of Staff General LeMay and Vice Chief of Naval Operations Admiral Russell.⁴⁴ DDR&E, under the direction of McNamara, was to make the minimum number of changes possible to the Air Force design to meet the needs of the Navy. Within a month, they wrote the directives and requirements. They were sent to the aircraft industry on 1 October, with a delivery of design date by 1 December 1961.⁴⁵

The aircraft industry was a very unstable business and also highly parochial in nature. Grumman and Pratt and Whitney worked almost exclusively with the Navy. Boeing had several Air Force contracts, but had never worked with the Navy.⁴⁶ Both services preferred working with contractors that had experience within their realm. Boeing had been working with the Air Force on TFX for almost two years and had

originally designed some of the prototype models for NASA to test.⁴⁷ General Dynamics was a solid company that had built several Air Force aircraft, but partnered up with Grumman and Pratt and Whitney to give them greater appeal to the Navy.⁴⁸ Whoever won the contract design, due to the joint nature of the venture, was bound to gain financial stability for the next decade with the \$6.5 billion contract that the TFX represented. For Boeing, it would make them the biggest aircraft company in the world; for General Dynamics, it was a matter of survival.⁴⁹ They had lost an estimated \$495 million the previous year on a failed corporate venture into the commercial jet industry.⁵⁰ They would surely face bankruptcy if they were not awarded the program.

The civilian leadership stayed out of the first two rounds of competition with the exception of giving directions for the next round. After the second round failed to provide a clear winner, McNamara started to become upset that the process was lingering.⁵¹ His mood was not helped when the services requested that the versions be allowed to diverge from a single aircraft design. This was the exact thing that he wished to avoid and undermined the whole point of a joint acquisition program.⁵² In February 1961, he envisioned a single aircraft that would meet all four services tactical air needs. He was forced to depart from that goal in May 1961. Now, in May 1962, it looked like he would not be able to get a single aircraft for the Air Force and Navy. He instructed his staff to do an analysis of the divergence. His office returned with a report stating that weight could be reduced for a Navy version of the aircraft while still maintaining enough similarity to reserve the inherent cost savings of a joint program.⁵³

McNamara authorized another round of study, but was very impatient to have the process completed. He authorized only three weeks for the next round.⁵⁴ At the same

time, he started a secret study of the program by private consultants. The study concluded that the program would likely have large cost savings, but similarity between the two aircraft would have serious implications on weight for the Navy. The private consultants warned McNamara that the Navy may never be comfortable with the version due to weight issues, especially since aircraft had tendencies to increase in weight as they were developed.⁵⁵ Interestingly, McNamara did not use the Department of Defense comptrollers and its collection of systems analysts to evaluate the TFX, though this was their primary purpose.⁵⁶

When Secretaries Korth and Zuckert reported that the Navy was unhappy about the testing of the third round and wanted one more competition, McNamara was clearly displeased.⁵⁷ The Selection Board wanted to award the project to Boeing outright, but the service secretaries suggested that each company be offered the ability to resubmit. McNamara concurred with their idea and agreed to a fourth competition.⁵⁸ He was concerned about two major factors: cost estimates and similarities. He felt that both companies had offered overly optimistic estimations of the total cost for the program. McNamara had spent the previous year looking at the cost of development for various defense projects and was appalled at the waste. Companies were not held to standard on the cost estimates and too often were awarded projects that cost two or three times the original estimation. McNamara also felt that the requested design divergence of the two aircraft was too large. He wanted as similar an aircraft as possible.⁵⁹

The fourth competition began on 1 July 1962. Two weeks later, McNamara wanted to make sure that his vision for the aircraft was understood by the two aircraft designers. He had Deputy Secretary of Defense Roswell Gilpatric draft a letter to both

Boeing and General Dynamics. In this letter, he laid out three conditions that had to be met in order for the contract to be awarded for their design. One, the tactical air capabilities of the aircraft had to meet the satisfaction of both the Air Force and Navy. Two, preserve the minimum amount of divergence from a common platform in order to protect the inherent cost savings of a joint program. And three, demonstrate a deep understanding of the costs of both the development of the aircraft and the procurement of the complete weapon series for its originally programmed life.⁶⁰ The three points demonstrated the factors that McNamara would use to judge the outcomes of the program. He wanted an aircraft with realistic total-life costs, has close commonality between its variant, and could satisfy the needs of the services. He never sent a copy of this letter to Air Force or Navy officers on the selection board.

Three weeks prior to his landmark TFX decision, McNamara gained another strong foothold with President Kennedy on military affairs. During October 1962, McNamara was at the White House daily, working with Robert and John F. Kennedy to navigate the Cuban Missile Crisis. The naval blockade and secret international agreements allowed the US to score a psychological victory over the Soviet threat. McNamara gained the unending support of the President and his staff. He could do whatever he wanted with the DoD and Kennedy would support his judgment.

General LeMay and Admiral Anderson submitted their decisions to the Service Secretaries on 8 November. 21 general and flag officers unanimously agreed to go with the Boeing aircraft.⁶¹ LeMay's decision for a source selection had never been overturned by the Secretary of the Air Force or Defense. When McNamara met with Zuckert and Korth on 13 November 1962, he would do just that. This decision was shocking to the

services, but made perfect sense to Robert McNamara. He had several reasons for his reversal of their first choice for the TFX.

The biggest problem with the Department of Defense, according to McNamara, was the cost of development and procurement in military acquisitions. Industry was rewarded for using “cost optimism” in developing their projects. It was a systemic problem for all of the services. Under cost optimism, companies that gave the lowest bid were awarded the project and suffered no adverse effects when the cost later rose over the agreed-upon contract. The government would eventually pay many times more than contracted for a project through its life cycle. In sampling twelve major weapons systems development programs, McNamara’s analysts, Peck and Scherer, did an examination of the variance from the original contracts over the previous decade.⁶² They analyzed each contract on a basis of time, money and performance (the same valuation tools McNamara planned on using against the TFX). The results confirmed what McNamara feared. Contracts took an average of 36 percent longer than contracted to complete. The performance had only one percent difference, meaning that it was almost always met. However, the projects had an average of 220 percent increase over the original contract cost.⁶³ This was a trend that worried McNamara. In 1945, the Research and Development costs of the military represented only \$500 million, five percent of the DoD budget.⁶⁴ By 1953, this number had increased to a \$2.4 billion, and in 1962, had increased to over \$7 billion, taking up 20 percent of the overall military budget.⁶⁵ Cost increases were a clear and present danger to the DoD.

McNamara felt the biggest problem was that the government shouldered all of the responsibility for the project and all of the risk. Most contracts were offered under the

cost-plus-fixed-fee contract for the military.⁶⁶ Under this type of contract, the government agreed to pay a company a fixed fee based on the total cost planned for producing the item in question. However, the target cost of the project was not binding to the manufacturer because the government agreed to pay for all of the actual production costs of the item. If it was supposed to cost \$10 million, but ended up being \$100 million, the government would pay the difference without penalty to the company. Under cost-plus-fixed-fee, the manufacturer had no incentive to stay within costs or minimize costs because they were guaranteed a fixed fee by the government and all of the unforeseen costs were not their responsibility. It might seem like companies would then underbid contracts, but the fee portion had the opposite effect. Their fee was based on the total expected costs, so companies would inflate costs to get a larger fee and then had no incentive to stay within those cost expectations. The Eisenhower administration was focused on innovation and invention, not on the total cost. In fact, most companies refused to bid unless it was a cost-plus-fixed-fee contract.⁶⁷ The Eisenhower administration agreed to this demand for two reasons. One, the government could keep much better control over the scope of the project since the company would have to deliver detailed reports and announce any expected cost overruns. Second, because all of the technology was so new, the companies would not agree to take on the project if it involved unproven or new technology. They would only agree if the government would back all of the costs in weapons development.⁶⁸

McNamara had a Harvard Business School background, where he taught before the war and was a student prior to that. He believed that he knew a way to get everything and save the government money at the same time. He would change from the archaic

cost-plus-fixed-fee contract style to an incentive based contract.⁶⁹ The worst thing the government could do was to assume all of the risk, as it offered no incentive for the manufacturer to stay on schedule or on cost. It encouraged faulty cost estimates and misallocation of resources. However, if a company were incentivized for staying on cost, schedule and production capability, then it would benefit both the government and the company (as they would get bonuses for staying in parameters).⁷⁰ McNamara pushed for the TFX to be a firm-fixed-incentive-fee contract rather than then cost-plus-fixed-fee.⁷¹

In this firm-fixed-incentive-fee contract, the government would still assume some cost expectations, but it would cut into the possible bonuses for the contractor, giving them incentive to stay on budget. McNamara spent an inordinate amount of time researching DoD contract styles and the cost savings the different types might offer the military. It also showed his dedication to cost estimation and how important a factor this was to him. McNamara looked at the Boeing and General Dynamics proposals and did his own cost analysis of the program. He believed that Boeing had underestimated costs by 21 percent on their bid, while the General Dynamics estimate was slightly more realistic at only eighteen percent low.⁷² Although only three percent separated the numbers, McNamara thought that General Dynamics had a much better handle on their cost estimation than Boeing. The Navy and Air Force selection boards had concluded that the cost estimates were low as well, but gave General Dynamics only fifteen points of advantage over Boeing for cost estimation/management in the scoring of the two proposals.

McNamara took in the inputs from Boeing and General Dynamics, compared them to the Air Force estimates and determined that they were all faulty. The cost

estimations for the development were now approaching a billion dollars, and that was before actual production had already begun. McNamara pulled all of the data in to make an evaluation for himself. A staffer commented, “The Secretary said that, after finding the Air Force estimates inadequate for judging the cost implications of the two proposals, he had made enough rough judgments of the kind he had made for many years with the Ford Motor Company.”⁷³ The way that McNamara went about this was to analyze the technical and design approaches that each company would use and compare that with their cost estimations. After several days, he concluded that Boeing’s designs were riskier because they promised the larger amount of advances in technology. He was skeptical of the Boeing design because it offered much better performance than the General Dynamics version. These performance advances were based on a series of extras that would have to be built through development processes. He found that the Boeing proposal did not match with cost realism.⁷⁴

Secretary of the Air Force Zuckert offered another complication to the cost estimation issue for Boeing. He reported to Secretary McNamara that he was worried about the man-hours- per-pound ratio that Boeing was using in their cost estimations. This ratio was used a rough indicator of the costs in aviation. Boeing’s estimate for this ratio was 20, while the standard in most aviation projects was at least 26 for fighter aircraft.⁷⁵ Boeing had based their ratio on their extensive experience with developing bomber aircraft. Specifically, they had long production runs of the B-47 and B-52. The problem with that estimate was that the length of the production run helped reduce the amount of cost per man hour. Also, neither aircraft was a huge technological leap, like the TFX represented. Zuckert was concerned that Boeing’s experience with building

bombers would not translate to the production of a fighter aircraft like the TFX, especially since it was based on such a large technological advance.⁷⁶ He went on to question the ability of Boeing to even produce a fighter, as the last fighter Boeing had produced was the P-26 in 1939. The company had never built a standard supersonic fighter, much less one this complicated.⁷⁷

When Secretary McNamara looked at the General Dynamics and Grumman proposal, he was not happy with their cost estimations either. However, he thought they had a better understanding of the costs involved with the TFX development. General Dynamics had planned on more research and development of the aircraft, along with a more extensive test program in wind tunnels. Their aircraft also did not rely on as many technological advances or use of complex materials like titanium (the Boeing aircraft used a large amount of this metal). General Dynamics and Grumman both had experience in building fighter aircraft, and had both built supersonic aircraft in the past few years for the military.⁷⁸ Grumman had extensive experience with the Navy building carrier-based aircraft and General Dynamics had built two of the Air Force century series fighters. McNamara concluded that General Dynamics/Grumman was more understanding of the requirements of the TFX and would therefore have the more realistic cost estimation of the program. Boeing's cost estimate was \$150 million less than that of General Dynamics, but he felt the end result would be cheaper. Boeing was just too risky monetarily.⁷⁹

This led to the question of aircraft performance. In the official competition of the aircraft, this was the only section that Boeing substantially outscored General Dynamics with the Air Force Council and Source Selection Board.⁸⁰ In the four areas being

evaluated by the Air Force and Navy (technical, operational, management, and logistics), Boeing was far behind General Dynamics in technical and management. Both companies virtually tied on logistics, with Boeing scoring a small advantage. However, it was this performance advantage that the Air Force pushed.⁸¹ The Navy concurred with these scores, but stated no real preference with the wording of their official stance. In the official correspondence with the Navy's leadership, BuWeap sent up a memo stating that –Overall, both designs are now considered acceptable. . . . there is no significant preference between the Navy versions of the two designs as submitted.”⁸² The problem was that the Navy officers had a personal preference, but none took it as the official stance of the Navy. McNamara took their official recommendations at face value: the Navy did not have a preference; both aircraft versions would do the job.

The very things that made the Air Force love the performance aspects of the TFX from Boeing, were the same issues that concerned McNamara. He was already accepting a tremendous amount of technical risk in the variable swept wings. The thrust reversers were an unproven technology, and he was not sure if they would work as advertized or rip the wing off of the airplane.⁸³ The second problem was the top-mounted air inlets. The Air Force preferred the top mounted air inlets to minimize the amount of Foreign Object Damage and to increase the unimproved runway capabilities. However, they were more expensive and McNamara did not agree with the need for this feature.⁸⁴ Finally, the last additional feature that appealed to both the Air Force and Navy was the extensive use of titanium. This titanium feature alone was enough to persuade Admiral Ashworth to agree with the other Air Force officers on the Source Selection Board.⁸⁵ McNamara was secretly briefed by Secretary of the Air Force Zuckert on this feature. Unbeknownst to

any member of the Source Selection Board or the Air Force Council, Zuckert had recently worked with the engineers of a current super-secret Mach 3 aircraft called the A-11, built by Lockheed Aircraft Company.⁸⁶ Because of the heat generated by speeds over Mach 2.5, Lockheed had done extensive testing on titanium and its stress tolerations. They informed Zuckert that Boeing's use of the titanium, especially in the hinge of the swept-wing, would not work without extensive re-engineering. Zuckert passed this information along to McNamara, but not the other Air Force officers.⁸⁷

Secretary McNamara and his staff looked at all of the performance features provided on the Boeing TFX version as extras. These were not included in any of the original statement of requirements and had not been part of the production needs. His advisors, including Secretary Zuckert, expressed doubt as to whether many of these were even possible. In McNamara's mind, he felt that these extras in the Boeing model added extra risk, not extra aircraft potential.⁸⁸ General Dynamics had relied on proven technologies, to include extensive use of aluminum and steel rather than alloys.

The final piece of McNamara's decision was based on the question of commonality. Here was another case where the preferences of the services were in direct conflict with his wishes, and in this particular case, he issued guidance. The 13 July letter to the presidents of Boeing and General Dynamics made it clear that commonality would be one of his priorities in choosing the winner of the aircraft competition. The services preferred Boeing in this regard because of the way that the two companies approached the problem. In Boeing's design, the separate versions allowed each service to get a little closer to what they wanted by creating two aircraft that were significantly different. General Dynamics' version came up with an acceptable aircraft by increasing the surface

area of the wing, forcing both sides to make compromises. McNamara viewed the divergent nature of Boeing's aircraft to be too wide a gulf.⁸⁹ He reasoned that two separate sets of development, testing and flight engineering would need to take place. It would increase development costs and double the chances for structural issues. Also, he felt that the divergence would only grow with time and eliminate any semblance of a joint aircraft.⁹⁰

Based on these three factors, Secretary of Defense Robert McNamara overturned the decision of all his Air Force generals and Navy admirals to pick the General Dynamics' TFX aircraft over the Boeing proposal. He made his decision reasoning clear in several memos to the Air Force and Navy leadership.⁹¹ They had no choice but to follow his decision, even if they had not agreed. But what McNamara did not count on in this case was the politics that are inherent to large programs.

Senator John McClellan (AR-D), a long time supporter of the Navy, immediately caught wind of McNamara's decision and directly questioned the reasoning. The project proposed to spend over \$7 billion in the next six years and represented a huge portion of the defense acquisition budget for the entire military.⁹² McClellan wanted to know if such a huge project was selected for political reasons, rather than those of altruism. He immediately had a large amount of fodder for this kind of thinking. General Dynamics had just entered into serious financial trouble. The end of their commercial jet program and the cancellation of the B-58 project spelled almost certain bankruptcy for the company if they did not get the F-111 TFX project.⁹³ Additionally, Vice President Lyndon Johnson was from the Dallas/Ft Worth area, the same area where General Dynamics had their main plant and employed tens of thousands of workers. General

Dynamics had been a large supporter of President Kennedy and he had direct ties to the company.⁹⁴ Also, Deputy Secretary of Defense Roswell Gilpatric did a significant amount of lawyer work for General Dynamics over the previous decade.⁹⁵

Senator McClellan quickly found a large number of connections between the administration and the General Dynamics Aircraft Corporation. He questioned McNamara's reasoning to overturn the judgment of the selection committees and all the military recommendations.⁹⁶ The Senate's Permanent Subcommittee on Investigations of the Committee on Government Operations soon was in full swing, investigating the TFX selection process. McClellan publicly questioned McNamara's motives, putting him on the defensive with the project all the way through 1963. He raised public doubt of whether McNamara could make good decisions, so McNamara was ultimately forced to make a strong public defense of both his decision and the project. Now, only a successful project would vindicate McNamara.⁹⁷

The hearings ended abruptly in November 1963 following Kennedy's assassination. No one wanted to question the connection of the late president to a military deal. Since the subcommittee was researching the political aspect, the McClellan hearings ended without any repercussions to TFX or Secretary McNamara.⁹⁸ But the damage was already done. McNamara could not allow the Navy to drop out of the program or for the project to get behind schedule. Any failure in the development would reflect back on his decision and the subcommittee could always reopen its investigation.

In 1964 and 1965, McNamara had little to do with the development of the TFX, but it did occasionally come back to him and his office. The contracts were written poorly, and denied the government access to a large amount of data produced by General

Dynamics. NASA spent most of 1964 working the General Dynamics version through their winds tunnels and came back with significant technological problems.⁹⁹ Pratt and Whitney and General Dynamics were competitors in many facets, so they did not share proprietary information with one another. This went largely unnoticed for over a year, as many people were focused on the variable swept-wings and not the development of the engines.¹⁰⁰ Only upon testing the engines did the manufacturer realize there was a serious problem with the turbo-fan aspect of the aircraft. A large part of the engine problem was the engine inlet, designed by General Dynamics.¹⁰¹ It was designed around the dash mission, not maneuvering.¹⁰² It created a form of distortion of the air flow into the engine, which was susceptible to this particular aspect of aerodynamics. The result was stalls, compressor feedback and an underpowered state for the engines. The inlet problem would plague the program for years, but McNamara had to make a decision on the project.¹⁰³

In April 1965, two major problems with the TFX were brought to McNamara. The weight problem had continued to grow and Navy resentment over the issue was growing as well. DDR&E recommended delaying the F-111B test development in order to redesign or address the weight gains in the design.¹⁰⁴ The engine inlet issue was brought up as well, and this put McNamara in a tough position.¹⁰⁵ The concurrent nature of the program assumed that there would be no major problems with design so that production and testing could happen simultaneously. He had to decide whether to make the full order, or delay for the results of testing since the Air Force had just received the first test aircraft. General Dynamics appealed to Congress, stating that every order lost or any delay would result in the loss of tens of thousands of jobs, putting pressure on

McNamara to continue the program. After a meeting with his staff and the Secretary of the Air Force and Navy, he decided to press forward with both production and a Navy redesign at the same time. This decision ultimately resulted in the numerous versions of the Air Force F-111.¹⁰⁶ It also revealed his emphasis on staying on time and showing the program was a success, even when not everything was working according to plan.

The escalation of events in Vietnam started to occupy more and more of McNamara's time. He was continuing to send more advisors to the area and made the decision in the summer of 1965 to concede to Johnson and send more and more regular Army troops to Vietnam. McNamara agreed with President Kennedy's decisions to withdraw more than a thousand military personnel in 1963. President Johnson reversed that decision, and several months later used the Gulf of Tonkin incident on 2 August 1964, to pass the Gulf of Tonkin Resolution in a nearly unanimous Congress.¹⁰⁷ It gave Johnson authority to send military troops to Vietnam, or any Southeast Asian country, without a formal declaration of war, as long as it was considered to be jeopardized by communist aggression. Johnson believed heavily in the domino theory and pushed McNamara to continue to raise the number of ground troops in Vietnam from 1964 to 1965 from 23,000 to more than 180,000.¹⁰⁸ Influencing the TFX project directly, the F-105 and F-100 were not performing well against anti-aircraft fire and surface-to-air missiles.

The Vietnam experience highlighted the need for conventional weapons and the aircraft that could deliver them. The biggest problem facing the Air Force was that they had several multi-million dollar aircraft that were focused on the nuclear mission. They were reluctant to send a \$20 million aircraft against insignificant targets and risk losing

the aircraft to a \$1,000 missile. They needed aircraft that could safely and effectively deliver conventional munitions in a conventional land war. The Air Force did not have many aircraft that could fill the role well, the F-4D being a notable exception. McNamara was vindicated on his choice for the joint F-4 program and returned his attention to the conventional capabilities of the TFX F-111.

In 1966, McNamara realized that Vietnam was a major issue and he did not know when the conflict would end. The number of US forces would more than double in Vietnam in just that year to 385,000.¹⁰⁹ The biggest problem facing aviation was the lack of conventional capability and McNamara felt that the F-111 could be very beneficial. He did not like what he found when he started to research the aircraft's progress. The Air Force results of the flight test were abysmal, with numerous flight test failures. The aircraft had a serious air inlet issue and was not authorized to fly in afterburner. Worse, it became apparent that the F-111 was developed as a nuclear bomber and may have little conventional capability.

McNamara convinced President Johnson to move Harold Brown from the head of DDR&E to Secretary of the Air Force and brought in Dr. John Foster to replace Brown.¹¹⁰ This new director focused on getting the F-111 back on track and to fix all of the production deficiencies. He addressed several large issues that continued to plague the aircraft. The first and most major was the stall inducing inlet problem. When Foster approached both General Dynamics and Pratt and Whitney, it became apparent that neither company was really working with the other. They blamed each other for the stall problem. General Dynamics contended it was an engine problem, while Pratt and Whitney argued that it was a problem caused by insufficient and disrupted air supply in

the air inlet.¹¹¹ Foster lacked the ability to attach legal responsibility to the problem. McNamara asked repeatedly who was responsible for the debacle, but no one had an answer. The government was left with the responsibility.

Foster was also concerned about the aircraft's nuclear focus. It lacked the capabilities the Navy needed for their fleet defense and did not have the target capabilities that McNamara wanted. He immediately did what had become a habit; he quickly found a board to research the problem. The President's Scientific Advisory Board, DDR&E and the Air Force Scientific Advisory Board all recommend a change to the avionics to increase its conventional capabilities. They recommend the MARK II avionics program.¹¹² The Air Force opposed the new avionics program, as it would be a change to the existing system and would focus almost exclusively on the aircraft's conventional aspects.

This multi-mission aspect appealed to McNamara and he approved the project.¹¹³ This also marked an important change in weapons procurement. DDR&E became responsible for supervising the development phase of all Department of Defense acquisitions. This was a function filled by the services earlier, but now would be consolidated within the Office of the Secretary of Defense.¹¹⁴ However, this particular decision was too late to affect a vast majority of the TFX, and would only find its way into a small number of F-111s in the D version and a modified MARK II in the F version. The MARK II program ended up costing over an additional billion dollars and never produced the reported capabilities.¹¹⁵

All of the problems with the aircraft, the SWIP program, the failed flight tests, the problems with the F-111B Navy version, contractual fights between the manufacturers

and mounting pressure from the Senate forced McNamara to become personally involved with the program again in August 1966. He started holding weekly and bi-weekly meetings with General Dynamics, Pratt and Whitney, DDR&E, and a variety of other specialists. The meetings became known as “Project Icarus.”¹¹⁶ Most important, Grumman Aviation, the Air Force and the Navy were not invited. McNamara took on the personal responsibility for solving the issues of the TFX aircraft and finding commonality and unity of purpose from the manufacturers.¹¹⁷

A political problem was manifesting itself for more than just McNamara. Senator McClellan reopened the TFX investigations in August of 1966 with the Permanent Subcommittee on Investigations.¹¹⁸ The schedule had been maintained despite continued evidence that there was a problem with the thrust, inlets, and engines of the TFX. The service secretaries had supported the continued development and production because it was politically impossible to oppose them. It would embarrass not only McNamara, but the administration as well. Now, with the subcommittee returning, the Air Force and Navy started to blame the lack of performance on a problem between the contractors rather than the decision of continuing in spite of problems.¹¹⁹ The political pressure would continue to drive issues, and the Navy officers started using this as a vehicle to kill their half of the program.

McNamara identified sixteen problems with the TFX program during the first Icarus meeting.¹²⁰ These were areas where he felt that performance estimations were not meeting the performance expectations of the aircraft. It was more than just the engine problem or the Navy’s weight issues; it was the ability to enact the deficiencies clause in the contract so that the government could hold industry responsible for delivering the

required product. McNamara viewed it as more than his political capital, it was him doing this program the right way.¹²¹

There was an issue between McNamara's focus on the TFX program and the numerous other problems facing the Defense of Department in 1966 and early 1967. McNamara repeatedly referred to the engine problem as something that must be resolved prior to the aircraft going into full production or even finalizing the production contract.¹²² In numerous statements, it was apparent that McNamara forgot that the aircraft started full production in 1965 and that he was the one who authorized it.¹²³ The aircraft had already been rolling off the assembly line for over a year and several hundred were past the point where an engine fix or avionics change could be incorporated into the body of the airframe. He did not realize that problems with the airframe, even if fixed at the Project Icarus meetings, would never be able to salvage the initial Air Force or Navy versions. The first F-111's were already being delivered to combat in Vietnam as he was trying to fix the development issues for the production contract at the end of Icarus.¹²⁴

McNamara would never get the chance to fix the F-111B. Senator McClellan successfully blocked the funds for the long lead-time production items for the F-111B, effectively killing its production.¹²⁵ He did not have to cancel the program; he just delayed it long enough for the Navy to find more substantial reasons for a permanent option. He found sympathetic allies in the officers at BuWeap who supplied him with the weight problems of the F-111B. In 1967, McClellan tried to get the program cancelled, but lacked the votes in the Senate. This was mainly due to the lack of a fleet defense aircraft alternative.¹²⁶ However, he was able to garner the votes necessary to block the

funding for another year. This would be all that the Navy needed in collusion with a number of personnel changes.

In June 1967, former Secretary of the Navy Paul Nitze became the new Deputy Secretary of Defense. McNamara became heavily involved with Vietnam and delegated all of the Pentagon business to his deputy. Nitze had originally been a huge fan of the TFX and believed that the opposition to it was parochially driven.¹²⁷ However, he now believed it would be detrimental to the Navy as a long term fleet defense aircraft. The Moscow air show demonstrated a series of new generation Russian fighter aircraft that seemed to be more technologically advanced than the F-111.¹²⁸ Nitze used this “Soviet threat” as an excuse to convince McNamara to authorize Grumman to do a study of the F-111 versus the new Soviet aircraft. Grumman returned not only with the news that the F-111B would not stand up to the new fighters, they returned with a new unsolicited aircraft design as well.¹²⁹ Now Senator McClellan had an alternative aircraft to present to the Senate when he next attempted to cancel the program.

The only barrier to the cancellation of the joint aspect of the TFX was McNamara himself. He announced his retirement to become the next President of the International Bank for Reconstruction and Development in November 1967. He was scheduled to retire on 29 February 1968.¹³⁰ Senator McClellan scheduled the next budget hearings for the Navy TFX version to begin on 1 March 1968. Clark Clifford, the new Secretary of Defense, agreed with the Navy’s request and McClellan’s push to cancel the program. Secretary Clifford had looked at the Air Force reports and knew that the aircraft was underpowered, especially for a conventional role.¹³¹ The Senate Armed Services

Committee voted to end the project on 28 March and the Navy TFX program was officially cancelled on 10 July, 1968.¹³²

A joint aircraft acquisition had never been attempted prior to the TFX aircraft. A jointly produced airframe seemed like a great way to get an asset to multiple services while utilizing the advantages of economy of scale and production. Higher numbers of an aircraft ordered typically resulted in a lower overall cost per copy. McNamara knew this intrinsically from his time at the Harvard Business School and as an efficiency expert at Ford Motor Company. He had exerted his will at other institutions with much success.

What McNamara did not anticipate was the number of players involved in a joint acquisition. Normal aircraft acquisition had a number of issues that were unique to each service and precluded involvement by several other governmental forces. However, the sheer magnitude and sweeping nature of this joint acquisition brought new interested parties into the mix. What can be ascertained from an analysis of the interaction of all these new players, the Secretary of Defense, the Air Force and the Navy in respect to joint aircraft acquisition?

¹George F. Lemmer, "The Air Force and Strategic Deterrence, 1951-1960," United States Air Force Historical Division Liaison Office, December 1967, <http://www.gwu.edu/~nsarchiv/nukevault/ebb249/index.htm#doc9> (accessed 2 April 2011), 22.

²Robert R. Bowie and Richard H. Immerman, *Waging Peace: How Eisenhower Shaped an Enduring Cold War Strategy* (Oxford: Oxford University Press, 1997), 99.

³Jules Roy. *The Battle of Dienbienphu* (New York: Carroll and Graf Publishers, 2002), 54.

⁴Charles H. Donnelly, *United States Defense Policies in 1957*, House Document No. 436, 85th Cong., 2d Sess., 1958, 83.

⁵U.S. Senate, Committee on Armed Services, Subcommittee on the Air Force, *Airpower*, Report, 85th Cong., 1st Sess., 1957, 554.

⁶Thomas K. Glennan, “Issues in the Choice of Development Policies,” in *Strategy for R&D*, ed. Marschak, Glennan, and Summers (New York: Springer Verlag, 1967) 47.

⁷*Ibid.* 50.

⁸U.S. House of Representatives, Committee on Appropriations, *Department of Defense Appropriations for 1958*, Hearings, 85th Congress, 1st Session, 1957, Part 1:36.

⁹A History of the Office of the Assistant Secretary of Defense for Research and Engineering, Assistant Secretary of Defense for Research and Engineering Website, <http://www.acq.osd.mil/ddre/organization/history.html> (accessed 5 April 2011).

¹⁰Department of Defense, A History of the Office of the Director of Defense Research and Engineering, http://www.dod.gov/ddre/ddre_history.htm (accessed 31 March 2011).

¹¹Robert J. Art, *The TFX Decision: McNamara and the Military* (Boston: Little, Brown and Company, 1968), 53.

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CHAPTER 5

TFX ANALYSIS

The three different perspectives into the TFX and F-111 acquisition offer a glimpse into the many opposing and complicated factors that affected the ultimate results. The Air Force and Navy had very different visions as to the type of aircraft they wanted, McNamara and the civilian leaders had their own agenda, and the aircraft industry was changing the way it did business. All of these competing dynamics resulted in what many historians label as a failed aircraft. It is important to note that the F-111 was not a failed aircraft. It flew for over 25 years, was utilized effectively by the United States and several other partner nations, and found a useful role within the ranks of much more sophisticated fighters for many years.¹ The F-111 filled the role of fighter/bomber for the Air Force and several other partner nations.

Analysts looked at the TFX as a failure through the lens of the aircraft. This is inappropriate as it denigrates the capabilities of the aircraft and significant technological advances the F-111 made in aviation. The lessons learned from this development were directly responsible for the advances in the B-1, F-15, F-14, F-16 and F-18 aircraft, all US modern-era fourth generation fighters and bombers.² Too much time is spent focusing on the TFX as an aircraft, rather than a process. The result of a large-scale joint aircraft acquisition process was the birth of several new concepts that would permeate the aircraft industry and the Department of Defense.

The process was the real problem when it came to the TFX. An analysis of the overall joint acquisition process explores where there were differences between the services and their civilian leadership. This kind of understanding highlights where

disconnects came from and may even shed light onto whether the TFX could ever have been successful as a joint program. However, beyond the psychology of the players, several central issues were apparent.

The very nature of joint acquisition is at odds with individuality and creates what can only be called a threat of commonality. Each service is constantly in competition with the others for a number of resources from the federal government. Typically the most important resource is funding, but that is not always the case. Sometimes the one thing more important than funding is relevance.

The Air Force was fighting to retain its relevance throughout the 1950s and 60s. It had fought against parochial interests ever since its inception and through two major world wars. Almost simultaneously with service independence, the nuclear mission developed. The Air Force was also fighting internal pressures for resources like the ballistic missile program and Strategic Air Command capabilities. The tactical application of atomic weapons gave them the specific role that made them relevant in a nuclear focused world.

The Navy had a much worse problem than the Air Force. The national requirement for a naval force was called into question by a military complex focused on air assets.³ The Navy watched funding and relevance slip away to the Air Force and Army in the early 1950s.⁴ The argument by critics was always the same: why give something to the Navy when the Air Force or Army can accomplish the same task? There was not an easy answer without talking about long-term strategic capabilities. Having the same aircraft as the Air Force (or Army, or Marine Corps) would be disastrous to the individual service identity and relevance.

McNamara, Zuckert and Connally were warned of the parochial nature of the Air Force and Navy.⁵ This was an accurate assessment of how the services would react to the joint program, but these civilian leaders did nothing to counteract the negative effect such feelings would cause a program that relied on inter-service communication. The Navy was upset that they were not the program's lead designers. It is unlikely that the TFX would have been a successful joint acquisition if the Navy had led the program. However, Air Force control ensured that BuWeap felt threatened by the process.⁶

BuWeap's failure to participate with the SPO was one of the worst decisions of the entire TFX program. The secretaries failed to understand that BuWeap was tied to all Navy development projects and had a huge influence over the way the project would progress.⁷ They controlled everything from requests to selecting the pilots that would ultimately test the aircraft. Abstaining from the equal share they were authorized was the first key failure of development. This single action showed the Navy's attitude to the program and their lack of interest in a successful solution.

The Navy accepted failure in almost every other aircraft they developed. The F-14 Tomcat failed more major milestones/development requirements and to a greater degree than the F-111B.⁸ The Navy bent numerous rules, requirements (such as missile types) and engineering time-lines to ensure that the F-14 program gave them a good fighter aircraft. Their major concern of weight gain was discounted with the F-14, F-18 and A-7 aircraft development.⁹ It is useful to explore the possible reasons the Navy was willing to overlook shortcomings for some aircraft and yet hold the line with the TFX.

The services work very hard to prove an aircraft of their own design. These aircraft are requested because they will fill a specific role and requirement that the service

feels it needs in order to accomplish its mission for national security. The mission capabilities and operational roles of the military services are perceived to be threatened at their very core by common (joint) weapon system developments. The natural reaction to this perception is to reject the joint program as not fitting within the mission needs of the service.

When the Navy rejected the F-111B, it was because they felt it never lived up to the high expectations of the aircraft. In reality, their rejection of the aircraft began before it ever started initial development. This was exemplified by Navy requirements that were constantly at odds with the requirements of the aircraft. The Navy added more weight to the aircraft than any other agency, while complaining about the very requirements they demanded.¹⁰ Between the Air Force and Navy, the F-111 more closely resembled in physical construction and capabilities the aircraft the Navy demanded. The final aircraft was drastically different than what the Air Force originally requested. However, the Air Force accepted the aircraft when the Navy rejected it. Had the Navy run the program, it is likely the situation would have reversed with the Air Force being dissatisfied with the end results.

McNamara thought the success of the F-4D Phantom II proved that joint aircraft could work.¹¹ The Air Force had accepted the aircraft into its ranks and the test pilots were very complementary of the performance capabilities.¹² What McNamara failed to understand was the difference between procurement and development. The Air Force accepted the F-4 because it was a known quantity that had already been fully developed and tested by the Navy. They made numerous changes to the airframe and armament, but were fairly happy with the aircraft.¹³ Their expectations and the reality of the aircraft

matched each other. In joint development, services are continually asked to make sacrifices in the name of commonality. This generally disenfranchises at least one party, making them feel they lost a capability due to the requirements of another service. In sole service acquisition, sacrifice based on a need made sense to the involved players and user. A self-initiated sacrifice is accepted as necessary, one that is imposed causes embittered rejection. This is especially true when services become fascinated with a certain technology or state-of-the-art advancement.

The technological problem began with the services themselves. The Air Force was never held responsible for the quick changing nature of the jet aircraft industry as top cruise speeds increased from 500 miles per hour to Mach 2.5 in a little less than ten years.¹⁴ They entered the process with the expectation that new aircraft could be quickly developed with small increases in capability over the previous version. The Air Force had done this in the past because they produced numerous jets over a short period of time. The F-111 represented a major revolution to the way that this process worked. The large technological leap that General Everest sought in the F-105 follow-on was the biggest change to avionics in years. But he had become accustomed to a relatively easy development and discounted the problems that small modifications in requirements would have on the physics of the airframe.

The Navy was just as guilty, but for the opposite reason. They understood the problems developing new and improved aircraft could represent and purposefully avoided it. Navy leadership was concerned more about the number of aircraft they could get in the air, rather than the technological capabilities.¹⁵ However, when offered the opportunity to invest in technology, they, like the Air Force, joined in.

The services were fixated on their requirements for the TFX. A repeating cycle had already begun with the programs leading up to the F-111. All four services were required to make selections as to what they wanted in the lines of aircraft (or other technologically driven machinery) before they actually needed it. Each service had to make these determinations in advance of the actual technology existing in order to get the maximum amount of money for research and to keep civilians from making the decision for them. Congress and the Department of Defense would approve the list of requirements through budget allocations, therefore making the services committed to whatever they had requested, even if it was no longer viable with the national security strategy or the needs of the service who requested it in the first place.¹⁶

Once the program was approved and funded, the civilian technical agencies (such as NASA) would become involved in the process. Many times, they would tell the service their requirements were either impossible or not congruent with their needs. However, the program was already approved and whether it was practical or not, the services were rigid. The most important thing at this point was development. As a result, any problems voiced by the contractor or outside agencies had to be filtered through the SPO or weapons bureau. It would never reach the decision makers at the service secretary or office of Secretary of Defense.¹⁷ However, when the technical problems did manifest, usually during testing, the senior civilian decision makers became aware of the problems for the first time and were frustrated that the aircraft did not meet the set criteria. Of course, the civilian agencies were warning of this all along, but their voices were drowned out by agencies whose livelihood relied on active projects. Not successful projects, just active ones.

The TFX was the first grand-scale exemplification of this problem. The Air Force oversold the technological capabilities of the aircraft to Secretary McNamara, all while hiding their true intentions for the aircraft. Even after the disappearance of players who wanted the aircraft for a certain reason, the lingering capability requirements of the aircraft drove the design. NASA and the Secretary of Defense comptrollers both warned about the technological problems with the aircraft. The Navy was skeptical as well. When a service is less than fully committed to a project, any deficiencies will enflame resentment and hostility over the smallest of compromises. However, billions of dollars were already invested in the TFX project before the Navy's concerns were validated, only serving to raise the stakes.

The major failing of the TFX program was that it asked too much of technology. McNamara and the services looked to General Dynamics to solve all of the issues with new and state-of-the-art innovations. Some of these innovations succeeded beyond expectations. The variable swept wing concept was a huge gamble that worked as advertised.¹⁸ The advances in radar, missile tracking and numerous other aspects of the aircraft were an unprecedented success. However, other aspects were not as good. The Mark II avionics, T-30 engines, inlet designs and aerodynamics were failings of the aircraft that would plague its reputation within the military.¹⁹

The risk of technological advances was one of the major factors that caused the rift between McNamara and the services in aircraft source selection. The services were enthralled with the list of technological wonders the Boeing version would bring to the aircraft industry. However, a great deal of their design was theoretical. The M-295 engines, extensive use of titanium, thrust reversers, and engine inlet designs were all new

design challenges on top of the variable swept wing.²⁰ McNamara probably accurately identified that Boeing would never deliver everything it promised in the TFX. This, combined with a lack of fighter experience or knowledge of supersonic aircraft, was enough to make McNamara question Boeing's ability to produce the aircraft they proposed.²¹

Cost estimates were McNamara's other huge issue. He had seen a pattern from the services that they could not recognize. The services had limited resources and funding from Congress, so in order to get more from their budget, they would encourage bids that were low or unrealistic. From this, they would get the support of the service secretaries and Congress. Once they had all of this support and dedication to the completion of a project, when the costs eventually and predictably rose, they were likely to get additional funds to finish the program. But the services were guilty of also giving high expectations of performance. They would label an aircraft as "state-of-the-art" to make it look more attractive to policy makers and irresistible to military leaders committed to never-ending one-upmanship with the Soviet threat. Therefore, industry producers and the services put forth proposals for aircraft that called for large technological advances for seemingly small amounts of money. McNamara viewed this as a systemic problem within the entire Department of Defense, but he was not immune to the allure of technology.²²

A vast majority of the inter-service problems with the TFX came down to the technology of the aircraft. Boeing and General Dynamics were asked to use technology by McNamara to solve an impossible problem. He wanted an aircraft that could do everything for everyone.

The TFX was the introduction of the multi-mission concept that would affect the aircraft industry for the next half century. Up to this point, aircraft were developed for a singular purpose and mission. Strategic bombing, air supremacy, close air support, and interdiction were missions supported by a single type of aircraft and very few were considered able to do more than one of these effectively. With the TFX, McNamara saw a new possibility for aircraft through the use of extensive technology.²³ He could design and develop an aircraft that could do these multiple missions, reducing the need for several different types of aircraft. With less variety, his supply chains would simplify and his economy of scale gains would enable more aircraft positioned around the globe.²⁴

McNamara cannot be blamed for thinking this way. The Air Force F-105 follow-on proposal was for a multi-mission aircraft. It was designed to be able to go across the Atlantic Ocean unrefueled, fly supersonic to a target undetected at low level, bomb the intended target and then dogfight against the most sophisticated fighter aircraft in the world.²⁵ In essence, the Air Force said it would be a ferry aircraft, could conduct strategic or conventional bombing, was a state-of-the-art fighter and could also be used for interdiction or close air support.²⁶ It could do everything. What McNamara saw was an aircraft that could do all of these missions individually. What the Air Force meant was that it could do those missions in support of its one true purpose: tactical nuclear delivery.

The Navy saw the TFX proposal as an albatross. It was too big and bulky for their needs. It could loiter for longer periods of time, but only if it had high loads of fuel. The top concerns for the carrier-focused Navy were size and weight.²⁷ The Navy had no need for a multi-mission aircraft; they wanted it for the singular purpose of fleet defense. Since this was their requirement, it made no sense to get an aircraft that was designed for

another set of missions and could accomplish their needs as a secondary condition. The multi-mission aspect of the aircraft is what the Navy used time after time to try to cancel the program. They needed a fleet defense aircraft, not a fighter or a bomber. The F-4 and A-6 gave them coverage for their other needs; the F-111 would only duplicate work already covered.²⁸

The multi-mission role for the TFX offered a great deal of the ambiguity that caused the program to be the focus of Congressional probes. Any aircraft designed for multiple roles would have to incorporate trade-offs and give up some capability. The aircraft that made a good ferry aircraft was in direct aerodynamic conflict with the best fighter. The size and fuel loads required would ensure slower turn rates and maneuverability, despite the function or position of the wings. With the title of multi-mission, no one was able to point to a specific mission-set and say that was the purpose of the aircraft. Therefore, it was judged against other aircraft that were solely designed for that specific mission. It fell short when put into those head-to-head competitions, especially with the Navy test pilots. Their opinion was that it did several things well, but excelled at nothing.

Once complete with the TFX program, both the Air Force and Navy focused back on single mission aircraft, developing fourth generation fighters in the F-14 and F-15.²⁹ The Navy developed the A-7 at the same time.³⁰ They made sure not to mix the roles between the F-14 and A-7, requiring two different aircraft to fill two different needs. The lack of a specific mission that the TFX offered to the Navy or Air Force made it hard to justify the expenditure to outside parties.

The military was in a competition in 1961 with the Department of Defense, who was filled mostly with civilians and scientists. The new DDR&E offered a great deal of advantage to the services, but also threatened their autonomy. DDR&E's suggestions and ability to control the rate and flow of military acquisitions was a direct blow to the way the Air Force and Navy conducted their operations. Secretary of Defense McNamara was the man who would give DDR&E and several other civilian organizations control back over the military.

Secretary McNamara was confrontational with the military from his first day on the job. The Limited War Panel he stood up within days of taking office was a direct indication of how he felt about the current situation within the military.³¹ He and the President deemed that the military had been running too long with no strong leadership or direction.³² McNamara would come in and help shepherd the services into a congruent strategic vision that met with the administration's view of the world. This meant taking the power back from the services and placing it in civilian control.

McNamara's choices for Secretary of the Air Force and Navy indicated how he viewed the situation. He was able to convince President Kennedy to appoint Eugene Zuckert as Secretary of the Air Force.³³ Zuckert believed the Air Force should be run like a business and utilize extensive cost-cutting procedures in order to help make wise financial decisions.³⁴ This appealed heavily to McNamara as he tried to reign in the military. Zuckert's replacement was Harold Brown, the former chief of DDR&E, a clear indication that McNamara felt the understanding of that office was helpful to run the Air Force.³⁵ Secretary of the Navy Connally was a political appointee as the previous aide to Lyndon Johnson, but he was replaced after only ten months by Fred Korth, a lawyer and

bank owner from Texas.³⁶ McNamara could count on Korth to make the right decisions based on financial sense rather than parochial interests. Finally, Secretary of the Navy Paul Nitze took over in 1963 after serving as McNamara's Assistant Secretary of Defense for two years.³⁷

McNamara's military panels almost always had active duty members on them, but they were never run by the military. He favored using DoD personnel or DDR&E. This allowed him to be confident that decisions were not being driven by dogmatic ways of thinking, but by what was in the best interest of the country. McNamara indicated several times that he was tired of the status quo, and the Air Force, Navy and Army did nothing but reinforce his image of their provincial nature. His need to step in with the 1 September memorandum was an indicator that he had no trouble laying out the guidance.

McNamara's decision could have been predicted. He was entirely focused and biased towards his experience with the Ford Motor Company and as an analyst of Air Force efficiency in World War II. As a lieutenant colonel he had been bullied by General LeMay, a man who was now his subordinate.³⁸ He was focused on efficiency and cost savings. But most importantly, he needed to teach the services a lesson on who would make the final decision. What better avenue for making this point than the TFX, where the final decision was essentially subjective. Then the service chiefs made their recommendation, and McNamara called into question their ability to make wise choices.

McNamara made a point about the TFX being a subjective decision, and he felt that his judgment was much better than that of the services.³⁹ When McNamara began the Icarus meetings in 1965, he built the group based on that same concept.⁴⁰ The military was not invited as members of the group, but rather as the subject of these meetings. He

felt that with his proper leadership and understanding of development that he could get the TFX back on track, fixing the issues he considered the services were manufacturing to be released from joint development. The irony of McNamara's Icarus meetings is in the name itself. In Greek mythology, Icarus was the son of Daedalus, a military inventor of complicated and intricate devices. Among these were the labyrinth of the Minotaur and a set of flying wings. Icarus, exercising hubris, took his father's wings and flew too close to the sun, causing the wax to melt and him to fall to his death in the sea.⁴¹ There is irony here as McNamara could be accused of a similar hubris.

McNamara tried to do everything himself, all while escalating the Vietnam War. This explains why he had so many lapses of understanding in the program's progress and status. After the McClellan hearings began, McNamara was trapped in an ideological loop. He was forced to stand by his decision, and not just for the sake of his reputation and political influence. Mostly he was forced to defend the TFX because flawed judgment from the Secretary of Defense would give credence to putting power back into the hands of the service chiefs. This would undermine the power base he worked so hard to pull up to the secretary level.

By the time Paul Nitze became the Deputy Secretary of Defense, he was extremely critical of the F-111B program and aided in shutting it down for the Navy.⁴² Nitze and Harold Brown started out as huge proponents of the program. They believed that the services were making decisions based on what was best for them, and not the overall military.⁴³ However, watching the TFX conflicts between the services and understanding their legitimate needs convinced Nitze and Brown that a joint acquisition sounded much better on paper than in practical application. The conflicts and influences

of the services were minor in comparison to many of the other factors that drove problems. They did not anticipate having to battle the aircraft industry, however. With their economic and political backgrounds McNamara, Nitze, Zuckert, Brown, Connally and Korth all expected the industry to make the best product for the lowest amount of money.⁴⁴

The TFX represented a critical period in the aircraft industry. Up to this point, there were numerous agencies and industry providers for the burgeoning aircraft industry. Not only was the military exploring the shift in air capabilities, but the civilian sector was growing exponentially in the 1950s. This offered plenty of work for all of the different companies. The industry was already starting to slow down and show serious signs of weakness by the time the TFX project was sent out for design requests. Two major events happened simultaneously that would change the way that aircraft were developed.

First, the size of the TFX project changed the stakes for aircraft companies. Up to this point, the Air Force, Navy, Army and Marines had all made independent aircraft requests for small numbers of aircraft that were not much more technically challenging than previous versions.⁴⁵ The high number of small bids ensured that lots of work was being offered on a consistent basis. If one company lost the bid for an aircraft, it was not catastrophic for the company. There would be another bid or requirement coming along soon.

The TFX was designed from the beginning as a seven billion dollar program. The Air Force would order nearly 900, with the Navy picking up another 350.⁴⁶ The buy would include two years of development and then a production line for another five years.⁴⁷ However, due to the cost of the aircraft and the multi-mission aspect of it, there

would be no other aircraft projects out for bid any time soon. The winner of the bid would have industry supremacy and be ensured of prosperity for several years. The losers of the bid would enter a period of aircraft famine and could likely seek bankruptcy before another bid came along. The TFX size and costs raised the stakes of the aircraft industry to the point that they were fighting for their perceived life of the company.

Boeing sought to solve the problem by throwing all of their internal assets at the aircraft design. They were proactive with the services, not realizing that they no longer were the decision makers for selection. Boeing's positive and proactive dealings with the Air Force were highly influential in the final decision of the selection boards.⁴⁸ They had confidence in the company and scored it according to the feelings of trust.⁴⁹ Boeing's advantages in scoring by the selection boards were based on intangibles offered by promises of capability. Boeing developed what the services wanted, whereas General Dynamics developed what Secretary McNamara wanted.

General Dynamic's plan for the competition unwittingly introduced the second major transformation that would plague future aircraft development. In order to contend against larger companies like Boeing, General Dynamics decided to share the costs and risks by bringing in partners. They added Grumman and Pratt and Whitney as aircraft development partners for several reasons.⁵⁰ Grumman had a long history with Navy development, which would help endear them to the Navy members of the board. Specifically, Grumman had experience with aircraft carrier development, a skill that almost all of the other competitors lacked.⁵¹ Pratt and Whitney had just developed new engines for the Navy in the T-30, the very engines that General Dynamics' executives thought would be a perfect match for their TFX aircraft.⁵² General Dynamics approached

the build and design of the aircraft like the Secretary of Defense: they would make it a joint program. This was brilliant in concept. Secretary McNamara mentioned several times that this confluence of ability between the companies is one of the major factors that made him select the General Dynamics aircraft version.

The same problems that plagued the military joint program also affected the civilian joint development between General Dynamics and its partners. The flow of information between the companies was lacking. None of the companies were co-located, so they relied on memo traffic and phone calls to solve technical problems after the initial concept. Also, when design problems arose, it became difficult to assign blame for the cause or assign responsibility for finding a solution.⁵³ Pratt and Whitney and General Dynamics refused to share proprietary information between each other, even though it was essential to wiring and troubleshooting engine problems. When the T-30 experienced airflow issues and compressor stalls manifested in the flight tests, both companies blamed each other for the deficiencies.⁵⁴ One said it was the engine inlet, the other claimed it was the engine itself. Both were right and both were wrong, as there was no clause in the statement of work to define who was responsible for the solution. The government was left with a legal mess and no one willing to accept responsibility. With multiple companies, each was responsible for only their piece of the puzzle, even if they did not fit together at the end of the process.

There was no real solution to the problem of proprietary information on aircraft design. Ultimately, these companies were partners and competitors at the same time. When the Navy started to gain traction for a possible cancellation of the program, it was Grumman who was asked to conduct the fighter study pitting the F-111B against the new

Soviet MiGs.⁵⁵ This was a conflict of interest. If the F-111B was produced in full, Grumman would only receive a piece of that design. However, with their history with the Navy and separation of the program, they would be free to develop a single source alternative to their favorite customer. That is exactly what occurred. Grumman concluded that the F-111B was inferior and immediately delivered an alternative design to the Navy that built on the lessons of the TFX and proprietary property of General Dynamics.⁵⁶ Grumman developed the F-14 Tomcat, a variable swept wing fighter aircraft using the redesigned T-30 jet engine for the Navy.⁵⁷ They financially benefitted from the intellectual failures of General Dynamics. Even General Dynamics learned from the situation and did not enter into a joint acquisition bid again. When tackling the F-16 in 1972, at the tail end of the F-111 production run, they entered the program without any support from other companies.⁵⁸

General Dynamics originally brought in partners to help improve their chances of getting the TFX program. They understood something that was revolutionary for the time: the more players involved, the more attractive it looks to policy makers. Those partners helped General Dynamics win the bid for the TFX, but also were partially responsible for the design failings. Just as joint aircraft design became more complicated with more players, so did the joint issue become more complicated for the military. It brought in new players that were typically not involved with aircraft development.

The size and scope of the TFX program attracted new problems to the world of aircraft development. McNamara pulled the decision of the TFX up to the Secretary of Defense level, thinking that it would help simplify the issue, reduce waste and ultimately

save time. However, he failed to understand that by pulling it up the chain, it invited new players into the mix, some of which were very powerful.

The lowest level of influence that was included was DDR&E and the Office of the Secretary of Defense staff. McNamara's own staff had to review and give opinions on everything that came from the service up to their boss. This meant additional staffing work and vetting of the information to ensure that the Secretary was getting correct information. Then to ensure it was not biased as well, McNamara would hire outside agencies to review the data and give him their opinion.⁵⁹ This trend would not go away, but increased with time. Outside critique of the process and consulting was a big dollar business that would only expand.

Congress rarely became involved in the business and decisions of the military services beyond budgetary approval of their needs. Like the aircraft industry, the bids were frequent and generally low enough to ensure that no single decision would affect any senator or congressman's political standing. However, the size of the TFX program and percentage of the military budget ensured there would be political intervention, despite the results of the decision. Senator McClellan and his subcommittee would have had cause to meet and question McNamara's decision even if he had gone with the services and chosen the Boeing aircraft. The fact that he went against the military highlighted this situation and gave Congress ample cause to investigate the selection process. The problem is that no matter how carefully conducted, there are always inconsistencies and conflicts of interest in aircraft source selection. McNamara was not a military man, so he was free from military motivations. This being the case, political

leaders wanted to know what his motivations were, as there were plenty of connections between the Kennedy Administration and both General Dynamics and Boeing.

The political aspect of this was the investigation. No matter the result, there was not a winner, except possibly the politicians involved. The politicians showed concern over taxpayer money and ensured that correct measures were taken to award the aircraft design. The power of the Secretary of Defense, along with his judgment, was called into question publicly. If he cancelled the program, he verified their concern. If he continued the program, he was justifying his decision. All the while the services were required to either back their leader or risk alienation.

Political influence on the system drove a time-based scenario. This caused development to drive forward whether problems were solved or not. There was not any time built into the program for unanticipated problems, which would inevitably happen. During flight testing, issues arose and modifications were required to solve the problem. However, the time-line driven production already had begun and forced increased production costs to fix the problem retroactively. The reduction of planned production volume by Congress was the most common reaction to this rising cost. Since the contract price was already set, the cost per copy exploded as the number ordered fell.

Ultimately, it was a political game. By reducing the number ordered, it appeared that political leaders were doing something to punish the company for the higher costs. But this single action would increase the per copy cost, giving them further reason to question the program. Once costs rose and caused concern over the development, it became politically impossible to continue to support the aircraft long-term.

Part of this problem was driven by the time-based scenario. Political pressure to keep up the manufacturing was tied General Dynamics' warnings about the effects of delays and reductions.⁶⁰ Stopping production to solve design issues for even a short period of time would lead to extensive lay-offs and company downsizing. No Congressman on a two-year election cycle could wait for the jobs to reappear in a couple of years. They had to keep things going, even if they did not like the aircraft.

The cost of compromise is underappreciated and is the main problem with joint programs. Most aircraft developers and political influences do not find any problem in compromise. It is necessary to cut deals, make laws and form a congruent aircraft design. This was as true in the 1960s as it is today. However, compromises cause the big problems in joint acquisition, as services often must give up some desired capability due to the needs of another service. This bitter reality of joint work was new to the military with the TFX.

The services were not cohesive in their operations in 1961, much less in their development of multi-service aircraft. McNamara was correct in his assessment that the services had parochial interests and wants. The Air Force and Navy were both used to an all-or-nothing system where one got what they needed and the other service waited for their turn. Never before had they been asked to deal with most of what they wanted. It went against their grain of understanding.

The services were unable to deal with the loss of capabilities that sharing required. The Navy, in particular, focused on the effects a joint aircraft denied them, rather than the positive things it provided. Every change they requested was designed to

make the aircraft more closely resemble their cancelled Missilier than build on the strengths of the F-111.⁶¹ The requests were self-defeating.

But as with all joint acquisition, a successful program required consensus. The TFX was plagued by numerous problems that would have been easily solved by a single service. The SPO and BuWeap would disagree on a solution to a particular problem. But since neither had the ability to make a unilateral decision, they would send memos back and forth between the agencies.⁶² Ultimately, enough time would expire, no solution would be decided, and the known problem just went into the aircraft because no one could agree on a resolution. The result was no solution. This was especially prevalent when the problem affected one service more than the other.

The idea of joint was the strongest appeal of the TFX project. In theory, it offered such great possibilities and potential for military development. If the services could accept something that worked for multiple services, then it would be easier to develop large programs that benefitted everyone for less money. Robert McNamara was one of the first people to truly look at the joint possibilities of the services. He felt he was strong enough, smart enough and had the will to force a new era in the military. However, all of these skills turned out to be hubris when everything did not go as planned.

Joint acquisition introduced new concepts and players no one ever expected. It went far beyond the services having parochial interests. That turned out to be the least of McNamara's issues. It introduced a new level of politics that he was not ready for or capable of affecting. It raised the stakes of the program to the point that it meant life or death to companies and forced them to take on bad business practices. Compromise and

time-lines became the driving factors rather than quality and efficiency. It soured the services to anything involving joint programs.

Joint capability was the single largest issue for the military over the next several decades. After the disastrous attempts at joint special operations missions in the late 1970s, Congress took notice and passed a series of laws to help promote joint capabilities. The most famous of these was the Goldwater-Nichols act, which changed the nature of joint operations. However, joint acquisition still suffers from some of the problems the TFX introduced.

¹Paul Eden, –General Dynamics F-111 Aardvark/EF-111 Raven,” *Encyclopedia of Modern Military Aircraft* (London: Amber Books, 2004), 122.

²Anthony M. Thornborough and Peter E. Davies, *F-111 Success in Action* (London: Arms and Armour Press Ltd., 1989), 87.

³Jeffrey G. Barlow, *Revolt of the Admirals: The Fight for Naval Aviation, 1945–1950* (Washington, DC: Naval Historical Center, 1994), 10.

⁴*Ibid.*, 17.

⁵U.S. Senate, *TFX Hearings–Second Series*, 4:874.

⁶Robert F. Coulam, *Illusions of Choice: The F-111 and the Problems of Weapons Acquisition Reform* (Princeton, NJ: Princeton University Press, 1977), 258.

⁷*Ibid.*, 261.

⁸David A. Brown, –Accelerated Testing set for F-14A,” *Aviation Week and Space Technology* 95 (20 December 1971): 49-53.

⁹Coulam, 272.

¹⁰U.S. Senate, *TFX Hearings–Second Series*, Letter to the Chief of Naval Operations, from the Chief of the Bureau of Naval Weapons, 5 February 1964, re F-111B Status, 2:401-404.

¹¹William H. Kaufmann, *The McNamara Strategy* (New York: Harper and Row, 1964), 247.

¹²Richard G. Head, *Decision Making on the A-7 Attack Aircraft Program* (Syracuse University, NY: Syracuse Press, 1970), 163.

¹³*Ibid.*, 165.

¹⁴Lou Drendel, *Century Series* (Carrolton, TX: Squadron/Signal Publications, Inc. 1980), 55.

¹⁵Robert J. Art, *The TFX Decision: McNamara and the Military* (Boston, MA: Little, Brown and Company, 1968), 26.

¹⁶Coulam, 190.

¹⁷U.S. Senate, *TFX Hearings—First Series*, Testimony of John Stack, 1:22.

¹⁸U.S. Senate, *TFX Hearings—Second Series*, 2:307.

¹⁹*Ibid.*, 311.

²⁰U.S. Senate, *TFX Hearings—First Series*, Written statement by Secretary McNamara, 2:375-376.

²¹*Ibid.*, 376.

²²*Ibid.*, 377.

²³Kaufmann, 121.

²⁴*Ibid.*, 124.

²⁵U.S. Senate, *TFX Hearings—First Series*, Testimony of Colonel Gregory, director of Requirements, Headquarters, Tactical Air Command, Langley Air Force Base, Virginia, 3:718.

²⁶*Ibid.*

²⁷U.S. Senate, *TFX Hearings—First Series*, Prepared statement of Secretary of the Navy Korth, 6:1462.

²⁸Coulam, 272.

²⁹Roy Braybrook, *F-15 Eagle* (London: Osprey Aerospace, 1991), 12.

³⁰Peter B. Mersky, “A-7 Corsair II in US Navy Service,” *International Air Power Review* 10 (Autumn/Fall 2003): 45.

³¹Kaufmann, 43.

³²U.S. Senate, *TFX Hearings—First Series*, Written statement by Secretary of Defense Robert S. McNamara, 2:376.

³³U.S. Senate, *TFX Hearings—First Series*, Prepared statement by Secretary of the Air Force Eugene Zuckert, 8:1900.

³⁴*Ibid.*, 1899.

³⁵Department of Defense Website, “Harold Brown,” http://www.defense.gov/specials/secdef_histories/bios/brown.htm (accessed 12 April 2011).

³⁶Spartacus Educational Website, “Fred Korth,” <http://www.spartacus.schoolnet.co.uk/JFKkorth.htm> (accessed 15 April 2011).

³⁷Spartacus Educational Website, “Paul Nitze,” <http://www.spartacus.schoolnet.co.uk/JFKnitze.htm> (accessed 15 April 2011).

³⁸Kaufmann, 24.

³⁹U.S. Senate, *TFX Hearings—First Series*, Written statement by Secretary McNamara, 2:387.

⁴⁰U.S. Senate, *TFX Hearings—Second Series*, 3:543.

⁴¹Carl J. Richard, *The Golden Age of the Classics in America* (Harvard University, MA: Harvard University Press, 2009), 33.

⁴²Katherine Johnsen, “Senate Unit Slashes F-111B Funds,” *Aviation Week and Space Technology* 87 (14 August 1967): 26.

⁴³Congressional Quarterly Weekly Report, “New Plane Seen More Costly, Little Better Than F-111,” 26 (3 May 1968): 1007.

⁴⁴Kaufmann, 118.

⁴⁵Coulam, 45.

⁴⁶U.S. Senate, *TFX Hearings—First Series*, 1:45.

⁴⁷*Ibid.*

⁴⁸U.S. Senate, *TFX Hearings—First Series*, Testimony of John Stack, 1:22.

⁴⁹U.S. Senate, *TFX Hearings—First Series*, 1:145.

⁵⁰U.S. Senate, *TFX Hearings—First Series*, Testimony of John Stack, 1:22.

⁵¹Interavia, "FFX: The Story Behind America's Largest Aircraft Program," 17 (November 1963): 1694.

⁵²Ibid.

⁵³Coulam, 183.

⁵⁴"Industry Observer," *Aviation Week and Space Technology* 85 (1 August 1966): 13.

⁵⁵Donald C. Winston, "Navy Studies F-111B Offensive Missions," *Aviation Week and Space Technology* 88 (23 October 1967): 29.

⁵⁶Ibid., 30.

⁵⁷Ibid., 31.

⁵⁸Doug Richardson, *General Dynamics F-16 Fighting Falcon* (London: Salamander Books, 1990), 54.

⁵⁹Art, 133.

⁶⁰U.S. Senate, *TFX Hearings—Second Series*, 2:324.

⁶¹Coulam, 145.

⁶²U.S. Senate, *TFX Hearings—First Series*, 7:1818.

CHAPTER 6

CONCLUSIONS

The concept of joint aircraft acquisition in the TFX aircraft was a failure. The Air Force only received a fraction of the original order and the Navy only accepted eight aircraft, all test planes. Though this was the result, it is not the real answer to what happened with development of the TFX. A complex, intricate web of needs by the services and supporting government agencies was in place well before McNamara entered into the equation. Not only did McNamara change the way services acquired their weapons, he changed every aspect of the system. Though he anticipated many of the challenges, the unintended consequences were greater and far more severe than the benefits he gained. Any small change to the aircraft development system was bound to cause complications, and he brought major change.

The Air Force went into the project with certain capabilities in mind for their next aircraft. When the needs and requirements of the national security strategy shifted with the Kennedy administration, the needs of the aircraft did not shift with it. They used the promise of multi-mission to mask the true intent of the aircraft amongst numerous capabilities. There was a focus on technological capability rather than technological need. The Air Force believed that if something was possible, then it would be a good idea to have it on one of their new aircraft. This focus on technological capability and upgrading is well documented. However, no matter how many changes happened to the aircraft, the Air Force never overtly sought to have the joint aspect of the program cancelled after it started. This is likely due to their span of control and stature within the program. It was nothing close to what they originally planned to build, but it was an acceptable aircraft.

The Navy could not have been more opposed to the aircraft. They entered into the TFX project with an idea of what they wanted, and it was not remotely close to the vision of the Air Force. Since they were forced into this program by the Secretary of Defense, they tried everything possible to get the program cancelled. Though these efforts did prove eventually effective, it also undermined the project for the Air Force. A study of the results of flight tests and internal memorandums reveals that the Navy could easily have made this an effective aircraft for their fleet. However, their lack of control was a crucial factor that doomed the project.

Robert McNamara never envisioned the political influence a joint aircraft would attract. He wanted to come in and do his job effectively. He believed that the job of the Secretary of Defense was to oversee the services and give them specific direction that benefited the military as a whole. On this count, he was right. Although political interference with source selection is now commonplace, it was unusual when McNamara took over as secretary. His actions set a precedent that was followed by almost all successors. And like McNamara, almost all of them have failed to fully predict the political repercussions of their joint decisions for service development. Congressmen often become involved when the stakes of any decision are raised to the point where it justifies their interference. At this point, any decision made will be attacked by some and lauded by others. Either way, it serves to slow down the process and require exponentially higher levels of diligence and political cover.

Recent examples of this include Congressional interference in the acquisition quantities of the F-22 Raptor, C-17 Globemaster III, Combat Search and Rescue Experimental replacement helicopter, V-22 Osprey, and J-35 Lightning II. It is not

coincidence that interference is most often found in joint programs, since three of those five were joint programs. Also, the F-22 was a competitor to the multi-mission J-35 program and was cancelled to make more money for this joint acquisition venture.¹

What can be learned from the TFX development? First, commonality will always be a factor with services. They have individual requirements and abilities that make their service distinct. Interfering with service identity will always be cause for concern. Though the services have become much better at joint operations in the last 20 years, there will always be a need for individuality. This is especially true since the services offer joint support without as much need for overlapping capabilities. The DoD should understand the consequences how they enter into the joint decision.

TFX development should be taken from a historical viewpoint, realizing that the Department of Defense, joint operations, and political involvement in military acquisition have all changed dramatically over the last 50 years. This paper was an analysis of the dynamics of the day versus universal truths in aircraft development.

The reasons joint developments are pursued are new technology and fear of costs. These are the worst reasons to conduct joint acquisition projects. New technologies have inherent problems in development solely based on the unknown. Joint support does not mean an aircraft has to be developed for multiple services, but rather that capability is available to multiple services -- a critical difference in the thinking of McNamara and current operations. New technology is so inherently risky, it threatens any project development with unforeseen risks. Joint and multi-mission development carry their own risks, and new technologies only serves to elevate this to an unacceptable level.

Concurrent multiple-service project development requires compromise between the two services and does not mesh with new technologies. McNamara tried to conduct a joint program that focused on a multi-mission aircraft, which relied on a huge technological breakthrough in aviation. The combination of all three of these factors proved too much for him and the services involved. Cost concerns will always be a political problem and will cause leaders to try to do too much in a single development rather than letting it progress slowly.

The biggest lesson the Department of Defense has failed to learn is with the aircraft industry. The DoD should never accept joint bids from companies that are competitors on other projects without clear contractual obligations of proprietary sharing and component responsibility. The sharing of information between agencies and likelihood of component conflict are astronomical. The competitive nature of the aircraft industry often overwhelms the feelings of cooperation for a single project. The author has witnessed on the V-22 Osprey the exact same problem that happened with the engine inlet of the F-111 and proprietary information between Pratt and Whitney and General Dynamics. In this case, Rolls Royce, who builds the Osprey engines, has an ongoing feud with Bell who built the wings and engine air particle separator. The Bell component feeds air to the engines, which have failed at a fraction of the contracted part's lifetime guaranteed hours.² Bell blames Rolls Royce for faulty engines, and vice versa. A very similar issue with the J-35 engine is currently being discussed in Congress.³

Multi-mission aircraft are the current focus of the Department of Defense. The TFX program shows the challenges of multi-mission aircraft when combined with other factors of development. The 1970s and 1980s were filled with single mission aircraft as a

direct result of the experience with the F-111. The F-111 eventually moved to a niche role within the service, but it was not the wide mission swath it was supposed to accomplish. Future multi-mission may aircraft face the same challenges. They will fail to be the best aircraft possible at any one particular mission. Multi-mission helps get an aircraft funded and built because it is appealing to Congress and leaders who want more for less. However, after it is produced, the user is left to explain why the aircraft is not capable of doing all of those multi-missions as well as older aircraft that were specifically designed for that role.

It is easy to assume that with technological and joint operational improvements that the modern military is impervious to the problems experienced by earlier eras in aircraft development. The Secretary of Defense called for a very particular aircraft when he testified to Congress about the multi-mission fighter he acquired for multiple services.⁴ He touted the money savings of joint acquisition and how a new joint multi-mission fighter would give new technological capabilities despite the numerous problems in its development and discrepancies between the needs of the Air Force and Navy. This was not Robert McNamara in January 1961, however. It was Robert Gates in January 2011.

¹William Matthews, “House Reverses Itself, Votes To Kill F-22 Buy,” *Defense News*, 31 July 2009, <http://www.defensenews.com/story.php?i=4214557> (accessed 1 May 2011).

²Defense Industry Daily, “V22 Osprey: A Flying Shame?” 31 March 2008, <http://www.defenseindustrydaily.com/V-22-Osprey-A-Flying-Shame-04822/> (accessed 1 May 2011).

³LSE, “US Navy, Air Force may field F-35s later than 2016,” 21 April 2011, http://www.lse.co.uk/FinanceNews.asp?ArticleCode=eonzqi07td0tkfi&ArticleHeadline=US_Navy_Air_Force_may_field_F35s_later_than_2016 (accessed 1 May 2011).

⁴Robert Gates, “Statement on Department Budget and Efficiencies,” Department of Defense Website, 6 January 2011, <http://www.defense.gov/speeches/speech.aspx?speechid=1527> (accessed 20 February 2011).

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